

**HOT NEW CARS**

FROM THE GENEVA  
AUTO SHOW **P. 48**

**BEST HOME BBQ**

BUILD YOUR OWN SMOKER  
**P. 124**

**THE OSPREY DEBATE**

DOES THE V-22'S COMBAT  
SUCCESS JUSTIFY ITS RISK? **P. 78**

**06.12**

VOLUME 189, NO. 6

POPULARMECHANICS.COM

# Popular Mechanics

AMERICA'S

# OIL BOOM

**SPECIAL REPORT:**

**HOW PRODUCT  
RECALLS  
MAKE YOU  
LESS SAFE**

**P. 84**

NOMINATED FOR

*Magazine of the Year*

BY THE AMERICAN SOCIETY OF MAGAZINE EDITORS

U.S. PRODUCTION IS RISING

**SO WHY  
ARE  
PRICES  
SKY HIGH?**

POPMECH INVESTIGATES

**P. 62**

• **Radical Racer:**  
The DeltaWing Hits  
the Track **P. 41**

• **A Brief History of  
the Surfboard** **P. 160**

*How-to*

**Step-by-Step: Make the Ultimate  
Computer Desk  
Build a Bicycle-Pump  
Bottle Rocket  
Install a Rearview Bumper Cam**  
**STARTING ON P. 115**

**Plus:** 20 Ways to Open a Beer Bottle (Without an Actual Opener) **P. 134**

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SEE IT IN ACTION





PopularMechanics

## IGNITION

Nick Woodman, founder of GoPro, with his twin HD Hero-equipped surfboard.  
page

74

06.12

## INSIDE



## IGNITION

Letters, Events, Editor's Note ..... 04

## TECH WATCH

News, Trends, Breakthroughs ..... 15

## UPGRADE

Gear, Tools, Gadgets ..... 27

## AUTO INTEL

Test Drives, Top Tech, Hot Rides ..... 41

## COLUMNS

Man With a Plan: Detailing a Bike .. 58

## FEATURES

**The Big Play** Advanced drilling technology has created an oil boom in North Dakota. Is it the key to U.S. energy independence? BY JAMES VLAHOS ..... 62

**Guts, Glory & Megapixels** How a surfer-turned-CEO revolutionized DIY video. BY ROBERT MORITZ ... 74

**Fixing the World's Most Complicated Plane** The V-22 Osprey is shedding its bad reputation with battlefield success. BY JOE PAPPALARDO ..... 78

**Total Recall** Defective products surround us, but flaws in the organizations that issue recalls leave the consumer in the dark. BY DAN KOEPEL ..... 84

## CONTRIBUTOR

Benjamin Lowy, photographer of "The Big Play," won the 2012 International Center of Photography Infinity Award for photojournalism. The seasoned war reporter's work for PM was safer but no less striking than his battlefield work.

**ON THE COVER** North Dakota's Bakken shale formation is the unlikely epicenter of the newest U.S. oil boom. But one question looms: How long will it last? Photograph by Jamie Chung

See page

62





## PopularMechanics

IGNITION

NEW: 25 PAGES OF DIY

W  
weekend

## TECH

Create the ultimate laptop desk ..... 116

## ADVENTURE

Build a bike pump track ..... 123

## HOME

Craft a steel-drum smoker ..... 124

## SCIENCE

Construct a power-saving gadget ... 140

## AUTO

Install a backup camera ..... 142

## WE'VE BEEN NOMINATED

## Magazine of the Year!

We're proud to be nominated this year for the highest honor in the magazine industry, along with fellow Hearst publication *Esquire* and three others. (The winner will be announced in May.) This nomination, by the American Society of Magazine Editors, encompasses both our magazine and its digital editions. We strive to uphold POPULAR MECHANICS' high standards—which you, our readers, have supported for 110 years—and will continue to deliver in print, online, on tablets, and on television. But now, if you'll excuse us, we're going to take a few minutes to celebrate!

AWARDS

"PM opens my mind to so many fields," Sherry Ling of Merritt Island, Fla., says. Here, she traverses the Panama Canal with her daughter Rachel.



?#@\*&amp;%!

## COMPLAINTS DEPARTMENT



## A Disservice to the Country

I've had a subscription to PM for 20 years but I'm letting it lapse. You consistently publish stories to laud the U.S. weapons industry. Spotlighting WMDs is a seal of approval. We spend everything on the military as the country crumbles. You encourage that. You are not helping America. — Mark Stevens, Brooklyn, NY

## What You Said

(ABOUT OUR APRIL ISSUE AND MORE)

We read all of your comments, tweets, and letters to PM—even the ones sent from maximum security prisons. Keep 'em coming!



## TALK TO US

email ..... [popularmechanics@hearst.com](mailto:popularmechanics@hearst.com)

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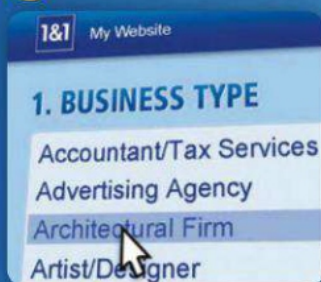
You had a lot to say about Glenn Harlan Reynolds's column "We Need to Dream Big Again," which argued that today's sci-fi books are more about escapism than technology. This focus in sci-fi, unlike that in the work of mid-20th-century authors such as Robert A. Heinlein, Reynolds wrote, is failing to inspire groundbreaking thought or careers in hard science. ● "The lack of engineering students doesn't stem from a lack of interest," Dan Niles, an engineer from Raleigh, N.C., wrote. "A career in engineering just doesn't pay." ● The article resonated with Maj. Gary Thomason of Arlington, Va.: "So much of what I've accomplished in life links directly to the influences of what I have read." ● "Thinking big will not change the fact that interstellar human travel is essentially impossible," Bruce Roland of Marion, Ohio, says. "It would be fascinating to see a science author go against the tide and



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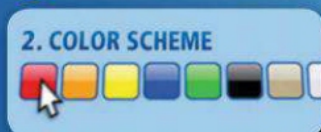
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come out and say it." ● Sean Sanderson of Jacksonville, Vt., dug into literary theory: "The best sci-fi plots have historically revolved around social topics. The technical aspects and infeasible scenarios provide a nice disguise for complex and often controversial social commentary. Given how much more progressive the audiences of today are, it makes sense there would need to be less disguise."

## Let's agree to disagree . . .

- I recently subscribed to PM after not having done so for several years. I just received the April issue and was underwhelmed by the content. In the old days, articles about repairing your car and maintaining your home made up the bulk of the magazine. This content was sparse in the latest issue. I hope in the future you'll return to the format that has served me and many other PM readers so well for so long.

CHARLES PYRON JR., SPRINGVILLE, AL

- As a 10-year-old boy, I read my dad's issues of POPULAR MECHANICS. That was many years ago. Last year, I subscribed to the magazine and found it as fabulous as I did as a kid. It's wonderful to be back in the fold, reading of the past and present and gaining a leg up on what the future holds. Thank you for being there for me as I continue to devour every issue page by page. JESSE WAYNE, BILLINGS, MT

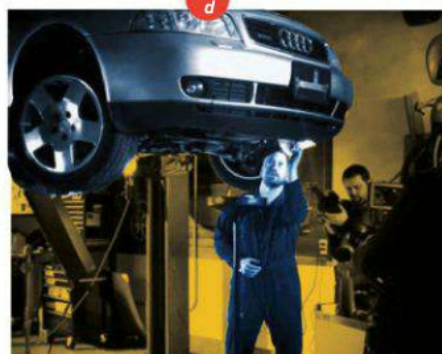
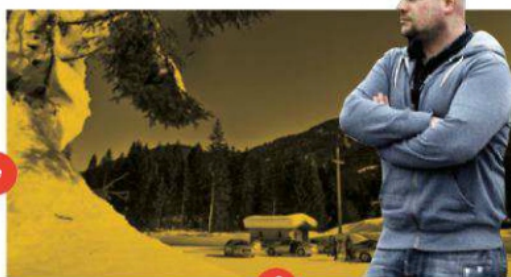
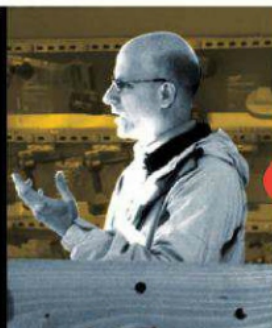
IGNITION

WHAT YOU SAID

## What We're Up To

(PM NEWS & EVENTS & STAFFERS ON THE SCENE)

(a) Senior home editor Roy Berendsohn helps lead the PM/Dodge Ram Home Safety Prep Show in Springdale, Ark. (b) Senior tech editor Glenn Derene speaks at SXSW in Austin, Texas, about why the location of your data matters. (c) Assistant editor Andrew Del-Colle tests the new Audi A8 Quattro on ice in Seefeld, Austria. (d) Associate auto editor Ben Wojdyla shoots an episode of *Saturday Mechanic* for PM brother publication *Car and Driver*'s YouTube channel. (e) Senior science editor Jennifer Bogo talks shop with future engineers at N.Y.C.'s FIRST Robotics Competition.



We're really busy in June

MAY 30-JUNE 3: World Science Festival, New York City  
JUNE 2: PM/Dodge Ram Home Safety Prep Show, Houston  
JUNE 9: PopMech Rebuilding Together Volunteer Day, Brooklyn, N.Y.  
JUNE 10: PopMech LIVE! at Nascar's Pocono 400, Long Pond, Pa.  
JUNE 23: PM/Dodge Ram Home Safety Prep Show, New Orleans



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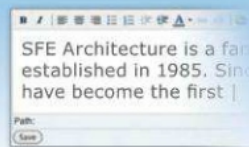
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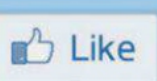
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### EDITOR'S NOTE

## Drilling for Facts

BY JIM MEIGS



ately we've been hearing a lot about the surge in U.S. energy production. But if we're pumping so much oil, how come gas prices are so high? We sent PM contributing editor James Vlahos to North Dakota's booming Williston region to report on the resurgence in homegrown energy. His story shows how drillers are pushing technology to its limits in tapping the extensive Bakken Formation of oil-bearing rock. ("Rockin' the Bakken," reads a popular T-shirt.)

But a welcome uptick in U.S. production is just one part of a complicated energy picture, as our investigation documents. Gas prices are mostly set by the global price of crude, and that is only modestly influenced by U.S. production. Still, drilling more oil in North America is a good thing; it means more jobs here at home and fewer U.S. dollars flowing to corrupt regimes overseas.

Gas prices are also influenced by government policy. And right now some of those policies do more harm than good. The White House has delayed the portion of the Keystone XL Pipeline that would move Canadian crude to U.S. refineries. And recent threats to raise taxes on oil companies might make for good political theater, but more taxes will raise, not lower, prices at the pump.

So let's applaud the hard work and good engineering that are squeezing more oil out of stubborn high-plains rocks. By all means, let's keep exploring smart energy alternatives. But let's also let the drillers do their jobs. **PopMech**

### IGNITION



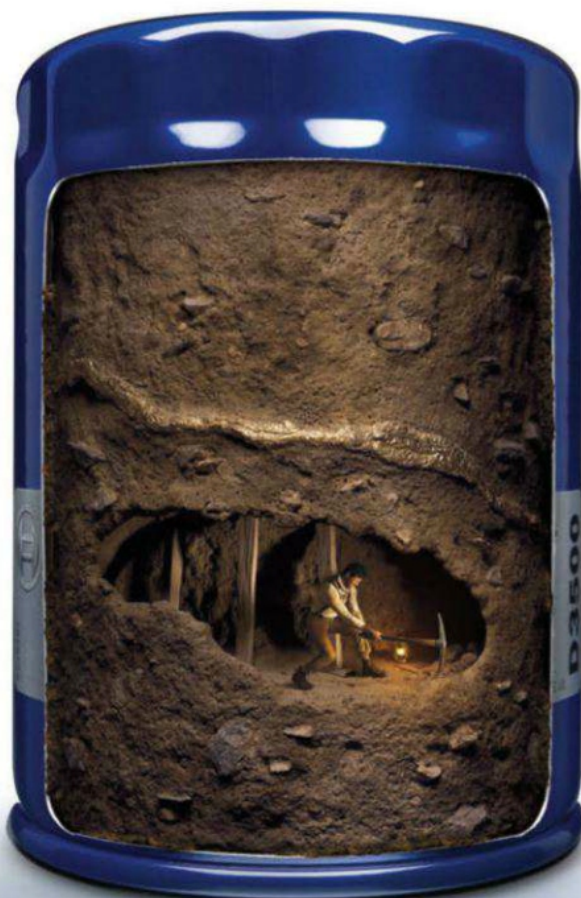
### Employee of the Month

**Michele Ervin** has the photo editor's gifts of a great eye and impeccable style. She is also mean on the compound miter saw, the MIG welder, and the sewing machine. Last year she started a business, Mervling, stitching whimsical bags using repurposed fabric and aged scrap leather. Check out her designs at [mervling.etsy.com](http://mervling.etsy.com).

Happy 100th birthday to Ralph S. Wilkes of Canandaigua, N.Y., who wrote for PM from the 1940s to the 1980s.



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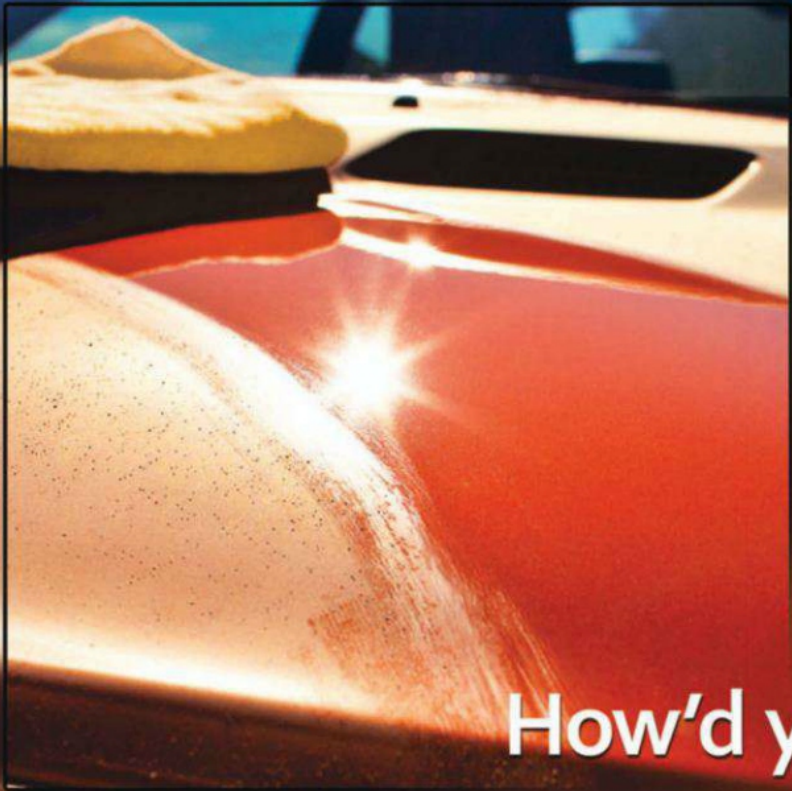
"What elements are in space? And if one of them were nothing, wouldn't that still be an element?"



Good question! We asked Neil deGrasse Tyson and Michael Shara, astrophysicists at Hayden Planetarium in New York. "Space contains all the elements except technetium and those heavier than uranium," deGrasse Tyson says. "They were made in the big bang and by stars that scattered their contents after supernova explosions." Shara adds: "The void of intergalactic space is full of photons, gravity waves, neutrinos, free electrons, and very dilute hydrogen and helium atoms." — *Steve Rousseau*

Angus Brochez, age 10, Burns Lake, British Columbia

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## THE POWER OF MAGLEV

○ Yes, magnetic levitation is best known for trains that float above the tracks and reach incredible speeds. But maglev technology could also lead to floating cities, lab cultures that grow in three dimensions (rather than only two in a petri dish), and launch systems situated many miles above Earth's surface that could fling spacecraft into orbit. [popularmechanics.com/maglev](http://popularmechanics.com/maglev)

## AMERICAN MUSCLE CARS



Pontiac GTO Judge, Oldsmobile 442, Ford Mustang Boss 429—you might recognize the great American muscle cars, but do you really know their histories? Visit us on the Web to learn which car needed a huge wing to let drivers open the trunk, which lacked a 1983 production version, and more. [popularmechanics.com/musclecars](http://popularmechanics.com/musclecars)

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TRENDS

BREAKTHROUGHS

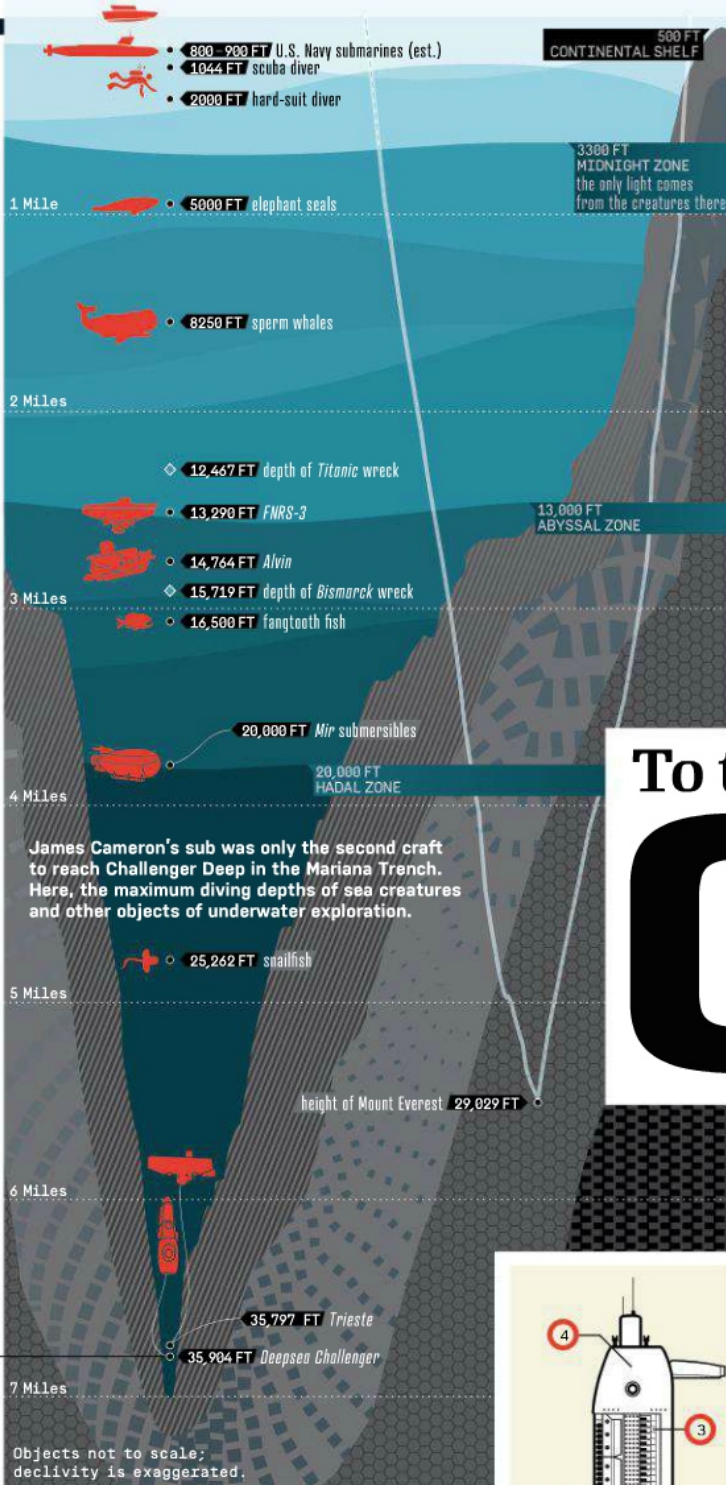
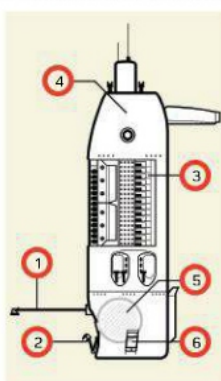
1

## EXPLORATION

## To the Abyss

**O**n March 25, James Cameron became the third person—and the only one traveling solo—to visit Challenger Deep, 6.8 miles below the western Pacific Ocean's surface. With the help of the Australia-based Acheron Project, the director engineered the *Deepsea Challenger*, a one-of-a-kind vertical-descent submersible equipped with HD 3D cameras [1], tools to gather scientific samples [2], and specially designed batteries housed in plastic cases filled with silicon oil [3]. Instead of building the sub out of steel and using foam to make it neutrally buoyant, Acheron created a new syntactic foam—epoxy resin containing hollow glass microspheres—that serves as the main structural material [4]. Cameron sat in a 2.5-inch-thick, 43-inch-diameter steel sphere [5], where he controlled the sub with joysticks. *Deepsea Challenger* reached the bottom in 2.5 hours with the help of 1000-plus pounds of steel weights [6]. Cameron had to resurface after 3 hours on the seafloor because of a hydraulic leak—he flipped a switch to jettison the weights and ascended in 70 minutes—but by and large, the sub performed as planned. “Yeah, your life is at risk any time you go into a hostile environment like that,” he told *POPULAR MECHANICS* last fall. “But you trust the engineering.”

— ERIN MCCARTHY



Objects not to scale; declivity is exaggerated.



WORLD'S DEEPEST TWEET @JIMCAMERON

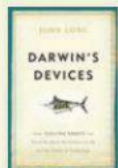
“Just arrived at the ocean’s deepest pt. Hitting bottom never felt so good. Can’t wait to share what I’m seeing w/you.”





## 60-SECOND GENIUS

WHAT CAN ROBOTS TEACH US ABOUT EVOLUTION?



John Long,  
author, biologist, and  
cognitive scientist:

TECH WATCH

**“**In our lab we conducted predator-prey experiments with evolving robots engineered to resemble fossil fish. These fish-like robots competed to feed better and flee predators faster. We used computer models to keep track of genetic changes. From generation to generation, we found that the robots became faster. We were evolving the tail, vertebrae, and lateral line but not the brain. People assume that human capability owes mostly to our big brains, but much of what we think of as *human intelligence* derives from the way the body is constructed. We also learned from the robots that *evolution does not always make for better design*. The number of vertebrae increased until reaching an optimal equilibrium, but tail size and shape fluctuated. Ultimately, the winning traits were passed on, which, of course, describes evolution.”

— AS TOLD TO  
ALISON BROWER

BY JOE PAPPALARDO

WHAT WENT WRONG

# Death of a Drone

HOW A LOOSE SCREW DOWNED  
A \$73 MILLION AIRCRAFT

The Air Force recently released the results of an investigation into the crash of a Global Hawk unmanned aerial vehicle that had been flying over Afghanistan. As in many aviation accidents, a small oversight led to a catastrophic failure. No one was injured, but the Air Force lost one of the few Global Hawks configured as a beyond-line-of-sight communication relay.

1.



The EQ-4B Global Hawk is flying 120 miles north of Kandahar, Afghanistan. It's being controlled by crew from Beale Air Force Base in California. At 1707 Zulu, 9.4 hours into the mission, controllers lose contact with the craft.

2.



Radar tracks show the Global Hawk pitching into a deep death dive 25 seconds after it experiences **lost link**. On the way down, the wings separate from the fuselage.

3.



Three minutes after contact is lost, the aircraft strikes the ground in the empty desert. U.S. forces bomb the remains to prevent the enemy from using the wreck to glean classified information or for propaganda purposes.

## PROBABLE CAUSE:

The EQ-4B's mission-management computer was unable to govern flight-control surfaces called ailerons. Insufficient capscrew torque (i.e., a loose screw) appears to have allowed a wire to work free, sapping power from the onboard computer and causing the aircraft to tumble from the sky.

## GLOSSARY



**LOST LINK:** When operators of an unmanned aircraft lose command and control. Military UAVs are preprogrammed to fly a contingency route to a rally point when this occurs; the malfunction that doomed the EQ-4B prevented it from completing this emergency command.



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APC power protection products are available at:



OfficeMax

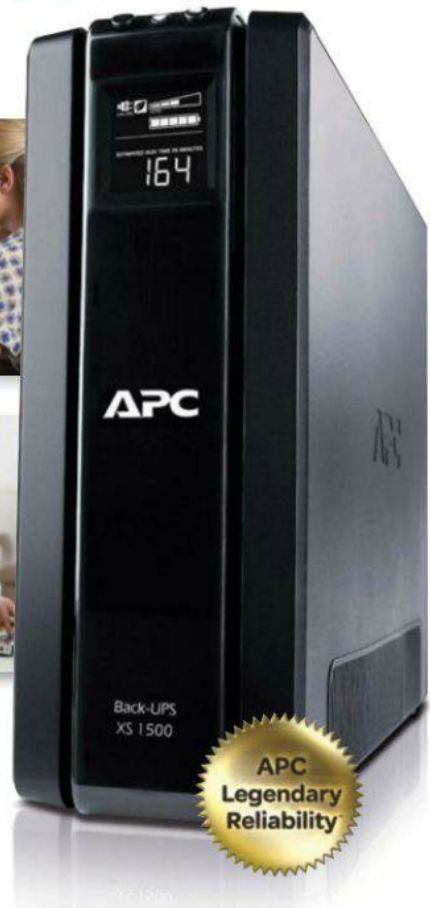


Office DEPOT



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### Keep your electronics up and your energy use down!

#### ES Series

The ever-popular ES models are priced affordably yet provide enough extended runtime to allow you to work through short and medium power outages. Some power-saving models have been designed to actively reduce energy costs.

#### The energy-efficient ES 750G

The ES 750G boasts innovative power-saving outlets, which automatically shut off power to unused devices when your electronics are turned off or asleep, eliminating wasteful electricity drains.

- 10 outlets
- 450 watts / 750 VA
- 70 minutes maximum runtime
- Telephone/network protection



#### The best-value ES 550G

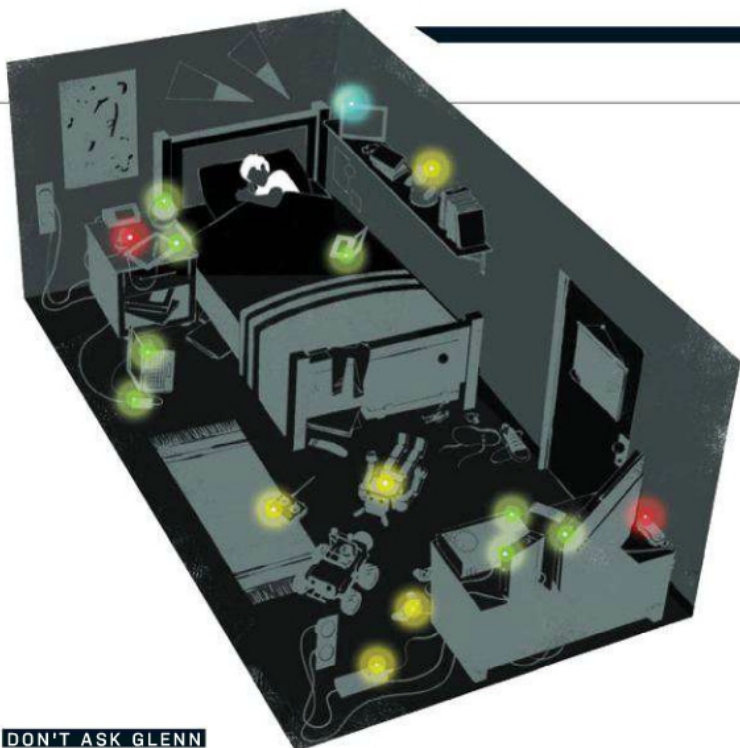
The ES 550 uses an ultra-efficient design that consumes less power during normal operation than any other battery backup in its class, saving you money on your electricity bill.

- 8 outlets
- 330 Watts / 550 VA
- 43 minutes maximum runtime
- Telephone/network protection



**APC**  
by Schneider Electric





In most cases, an indicator light simply lets you know the device is on. But most modern electronics are in a constant state of standby, so the LED glows whether or not a device is in use. Some gadgets blink while standing by; in sleep mode, Apple's MacBook Pro pulses its light like a synthetic snorer.

The LED indicator proliferation is due partly to the litigious nature of consumer culture. (Hedge cites manufacturers' fears of "failure to warn" lawsuits.) But most LEDs are added because product designers see no reason not to. "Often in the world of design, if you can afford to do something, you do it," Hedge says. But even if a functional case could

be made for each of these lights individually, in aggregate they just create sensory pollution and dilute the message each light ought to deliver: "Hey, something's going on with this device."

I'm a lover of electronics—but also a canary in this particular coal mine. If the glowing lights in my house indicate a trend, then I'd like to start the backlash now. Enough with the LEDs already. If there's no critical reason for a device to emit light, then it shouldn't emit light. We consumers are not afraid of the dark.



**DON'T ASK GLENN**

# LED Astray

WHERE HAS ALL THE DARKNESS GONE?

**W**hen I was a child, in the 1970s, my parents plugged in a 4-watt night light near my bedroom door to keep me from crashing into walls on my way to the bathroom. My two young sons don't need such a thing. Their rooms are lit by the soft glow of LEDs, seeping out of various appliances, toys, and electronic devices. Together they produce what I call the underglow. It has infiltrated every corner of my home, which I can navigate at night by LED beacons alone.

LED indicators are suffering from gratuitous overuse. Commercial light-emitting diodes were first used in Hewlett-Packard calculators in the 1960s, and in the '70s Fairchild Optoelectronics introduced a planar process that reduced the cost to pennies apiece. Today, the lights are everywhere, silently communicating: "Your phone is charging." "Your hard drive is working." "Your baby monitor is monitoring."

Alan Hedge, a professor of ergonomics at Cornell University's Department of Design and Environmental Analysis, says the lights should convey three types of "need to know" information: power (the device is on), warning (something's wrong), or confirmation of action (something's changed). All else is decorative or extraneous. "Good ergonomic design means you provide the appropriate amount of information," he says.

TECH WATCH

BY GLENN DERENE

NEWS  
BRIEF

**OF ACCELERATORS AND ART INVESTIGATIONS** The Louvre in Paris holds many of the world's most famous works of art—but most people never see the particle accelerator in its basement. Scientists use the machine to analyze the composition and origins of artwork. For example, the accelerator helped determine that the ruby eyes in a Babylonian statue of Ishtar came from a mine in Vietnam, indicating that the two regions established trade routes at least 4000 years ago. Such high-tech forensics are employed elsewhere in the art world too: An accelerator helped crack a \$36 million art forgery scandal in 2011, when its proton-induced X-ray emissions provided damning evidence about paint pigments used in the forgeries. — ALEX HUTCHINSON



Camping,  
Power Outages,  
Or "Honey, Did You  
Hear Something In The  
Backyard?!"



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Who says your outdoor adventures need to be "rugged"? With PEAK's full line of electronics, you can take your household power on the road, or to the campsite. With our Spotlights, Power Stations, and Mobile Power Outlets, you can enjoy the best of both worlds.



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## DEVICES IN DEVELOPMENT



## Voice Over

RESEARCHERS CREATE A DEVICE THAT CAN PUT A PERSON ON MUTE.

Until now, the only guns that could stop a person from talking fired bullets. But Japanese researchers have created a nonlethal version. The Speechjammer uses delayed audio feedback to reduce its target to a stammering mess. It does so by interfering with one's ability to process what has been said, explains Shanjing Cai, a postdoctoral associate at Boston University's Speech Lab (who was not involved in creating the device). "When you're producing speech, the brain tends to monitor the auditory feedback," he says. "The previous words in a sentence are used as triggers for the ensuing words." The Speechjammer's directional mic records the target's speech and rebroadcasts it on a speaker with a 0.1- to 0.3-second delay aimed at him or her. "The brain is essentially fooled into thinking the sounds or syllables it intended to produce have not been produced correctly," Cai says. That glitch causes the target to involuntarily stutter while the brain searches for the "correct" speech. Although the applications for this technology may seem Orwellian—a way to silence protestors—Cai predicts that the gun won't be effective against crowds. The goal is to help facilitate discussion, not end it, says Kazutaka Kurihara of the National Institute of Advanced Industrial Science and Technology, one of the inventors.

## NATURE'S ARMS RACE

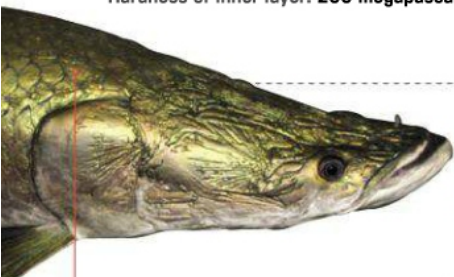
## Fish Faceoff

## ARAPAIMA

Scientific name: *Arapaima gigas*  
 Length: 6.5 to 8 feet  
 Habitat: Amazon River basin  
 Outer scales: Up to 4 inches long  
 Hardness of outer layer: 500 megapascals  
 Hardness of inner layer: 200 megapascals

## RED-BELLIED PIRANHA

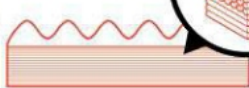
Scientific name: *Pygocentrus nattereri*  
 Length: 3 to 9 inches  
 Habitat: South American rivers  
 Bite force: 70 pounds (30 times its body weight)



VS



CORRUGATED SCALES ALLOW THE FISH TO FLEX AS IT MOVES.



ARAPAIMA SCALES HAVE INTERNAL LAYERS OF COLLAGEN FIBERS STACKED IN ALTERNATING DIRECTIONS TO ONE ANOTHER FOR MAXIMUM TOUGHNESS.

The Brazilian arapaima makes a large, tempting meal for the schools of piranha that share its river habitat. Good thing, then, that this prey's scales are impervious to piranha teeth; the scales have a hard, mineralized layer that covers tough muscle. Engineers at UC San Diego attached piranha teeth to a hole punch machine to simulate attacks. The teeth penetrated the scales partway, then broke. The researchers suggest that similar designs could produce stronger body armor, better insulation, and advances in aerospace technology.

— ALEX HUTCHINSON

## NEWS BRIEFS

## LIGHT FROM PURE CRYSTAL

The inventors are calling it "LED 2.0": a 12-watt bulb that produces 10 times more light than conventional LEDs. Rather than having a sapphire or silicon substrate like its competitors, the new bulb is made of pure gallium nitride crystal. That makes it more expensive, but Fremont, Calif.-based startup Soraa says the bulb pays for itself in energy savings in less than a year.

## BRAIN HACKING FOR ROOKIES

Forget chemistry sets—the next generation of amateur scientists will be plumbing the mysteries of the brain. The SpikerBox kit (\$99), developed by neuroscientists Greg Gage and Tim Marzullo, allows users to amplify and listen to neurons firing in invertebrates such as crickets and cockroaches. When connected to a smartphone, the kit can record and graph how the nerve signals respond to touch, temperature, and other senses. Backyard Brains, the company behind the SpikerBox, has also introduced RoboRoach (\$99), which allows home users to surgically modify a cockroach to turn left or right in response to electrical pulses. (Small set of three trained roaches, \$12.)

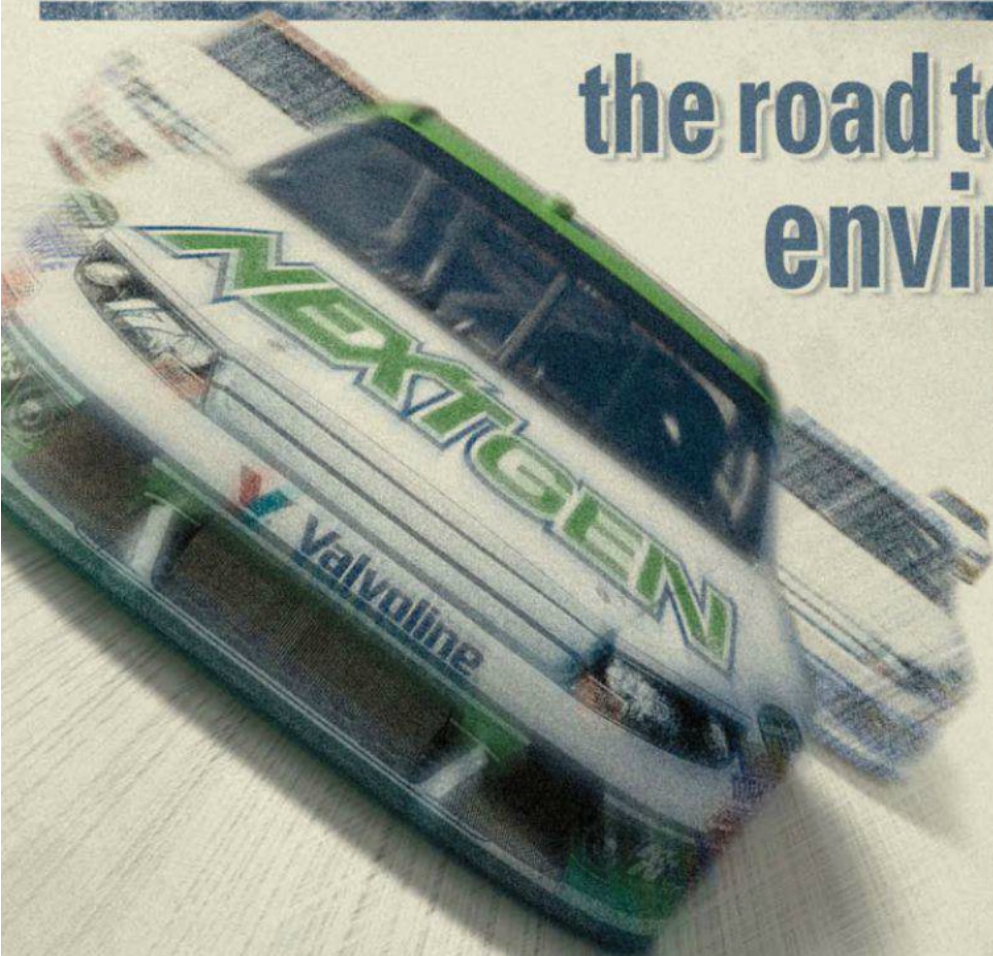
TECH WATCH



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Introducing Valvoline NextGen, a new breed of premium motor oil made from recycled oil that isn't just better for the environment, it's a winner on the track. We set out to prove that NextGen technology could withstand the abuse of NASCAR, so we challenged Roush Fenway Racing to run it in their cars.

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Taking victories at **Atlanta, Dover, Charlotte** and **Daytona**, they even won the **Nationwide Series Championship**, proving that what's good for the environment can be great for your engine. So what are you waiting for?

**Take the next step with Valvoline NextGen.**



*Congratulations to Matt Kenseth on winning*

**The Daytona 500** with **NEXTGEN** TECHNOLOGY



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# Visitor's Guide to ...

## THE MILKY WAY



ASTRONOMERS RECENTLY DETERMINED THE EXACT COLOR OF THE MILKY WAY: A VERY PURE WHITE, ALMOST MIRRORING A FRESH SPRING SNOWFALL.

BY SARAH FECHT

Scientists announced in January that 10 billion stars in the Milky Way may be orbited by Earth-like planets. Not only are these planets expected to be similar in size to our own, but they're also located in zones temperate enough for liquid water to form. That's good news for intergalactic tourism, says University of Copenhagen astrophysicist Uffe Jørgensen, who led the research. Jørgensen predicts that people will begin colonizing the moon and Mars, then eventually travel to planets around other stars. Here's what adventurous planet-hoppers should know before leaving home.



**Natural Wonder**

Nothing beats a double sunset. The planets Kepler-16b, -34b, and -35b each orbit two stars at once, much like Tatooine in *Star Wars*. According to new research, such double-sun planets may be common throughout the galaxy.



**Luxury Shopping**

Orbiting a pulsar in the Milky Way's Serpens, or Snake, constellation, may be the most beautiful planet you'll ever lay eyes on. It is certainly the most valuable. This rock is about five times the diameter of Earth and made almost entirely of diamond.



**Clubs and Nightlife**

Astronomers have found a mysterious haze at the heart of the galaxy. The light appears to be produced by an "absolutely enormous" cloud of energetic particles racing through the galaxy's magnetic field, but the particles' origin has so far defied explanation.



**Outdoor Recreation**

A small black hole named IGR J17091 produces some of the fastest winds in the galaxy—perfect for hardcore paragliding. The magnetic fields around the black hole cause material to rush away from it at about 20 million mph.

## BE SURE NOT TO MISS!



### HOME EXCHANGE

Located 620 light-years away in the Cygnus constellation, Kepler-22b is just 2.4 times Earth's size. It orbits a sun-like star and may even have Earth-like temperatures.



### FIREWORKS

Celebrate the birth of new stars at Cygnus X, one of the most active regions of star formation in the galaxy. Shock waves, intense UV light, and stellar winds create a spectacular show.



### SPA TREATMENT

At upwards of 450 F, the watery planet GJ1214b has a steamy atmosphere. Deep inside it, H<sub>2</sub>O behaves strangely, creating materials such as hot ice and superfluid water.



### HISTORIC LANDMARK

Two gamma-ray bubbles, each 25,000 light-years tall, straddle the galactic center. They're likely the product of star formation or the eruption of a supermassive black hole.

TECH WATCH







[odyssey.honda.com](http://odyssey.honda.com)



## VAN. MYTH. LEGEND.

The best-selling minivan\* in the land is vanlier than ever. Available features like a Split-Widescreen Rear Entertainment System†, a hard drive that fits thousands of songs,\*\* a USB Audio Interface†† and a leather-trimmed interior will have you riding in dazzling van glory. While a powerful and efficient 28 hwy mpg‡ V-6 engine will take you places you forgot existed. The van beckons. **Like no van before.**

# ODYSSEY

1-800-33-Honda \*Based on R. L. Polk & Co. U.S. retail registrations, Minivan segment, 1/08 - 11/11. †A separate source device is required to use split-screen function. \*\*Hard disk drive (HDD) 15-GB memory audio system standard on navigation-equipped models. ††The USB Audio Interface is used for direct connection to and control of some current digital audio players and other USB devices that contain MP3, WMA or AAC music files. Some USB devices with security software and digital rights-protected files may not work. Please see your Honda dealer for details. ‡19 city/28 hwy 2012 EPA mileage estimates for Touring models. Use for comparison purposes only. Actual mileage will vary. Touring Elite™ model shown. ©2011 American Honda Motor Co., Inc.



# MORE REASONS TO LOVE THE FILET MIGNON



## AKA:

Filet, Tenderloin Steak, Medallions, Tournedos, Tenderloin Tips, Filet de Boeuf (if you're feeling fancy).

## PREFERRED COOKING METHOD:

Grill, Broil, Stir-Fry.

## GOES WELL WITH:

Green Vegetables, Potatoes, Holiday Feasts.

## WINE SUGGESTION:

Sophisticated, Complex Red such as Cabernet Sauvignon.

## COOK TO:

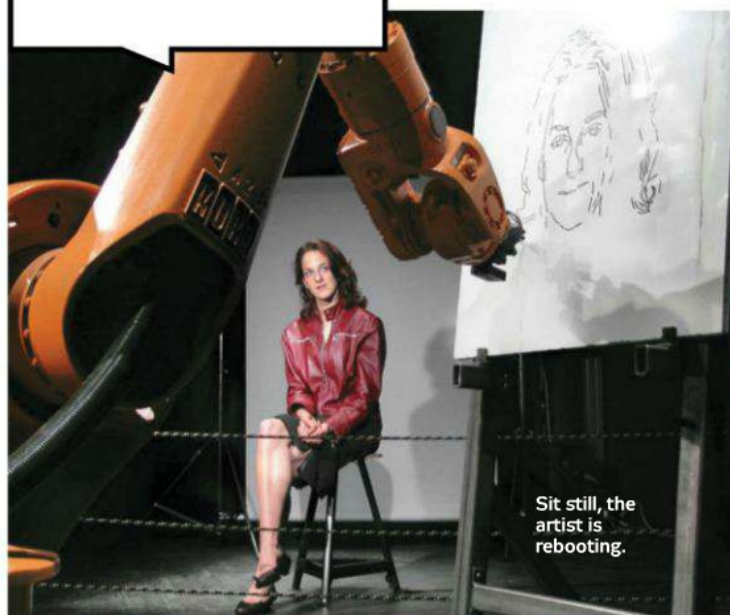
Medium Rare (145°F) to Medium (160°F).

**YOU GOTTA LOVE LEAN BEEF**

29 LEAN CUTS. ONE POWERFUL PROTEIN.



## NEWS BRIEF



Sit still, the artist is rebooting.

## Pencil Pusher

A REPURPOSED ROBOT FINDS A NEW CAREER IN PORTRAITURE. BY ALEX HUTCHINSON

An industrial machine has abandoned its day job to become an artist. Researchers at the Center for Art and Media in Karlsruhe, Germany, have taught a robot normally used to analyze the optical reflection of materials such as car paint or

safety vests to render portraits. The robot records an image with its camera, then applies edge-processing software to search for key facial lines. It sketches those in pencil, producing a reasonable likeness in roughly 10 minutes.



The robot's gallery



## NEGATIVE REFRACTION



REFRACTION



NEGATIVE REFRACTION

When light passes from one medium into another, it changes direction, or refracts, in a predictable way. (Put a finger in a glass of water and it appears to bend.) Researchers at Oregon State University have developed a way to make low-cost material that will bend light in the opposite direction, a concept known as negative refraction. The material is composed of smooth, ultrathin layers of custom-made glass arranged in a sandwich structure that manipulates the light. What is the material good for? Researchers say that controlling negative refraction will permit the development of superlenses that magnify objects too small to see with a conventional optical microscope. — A.H.

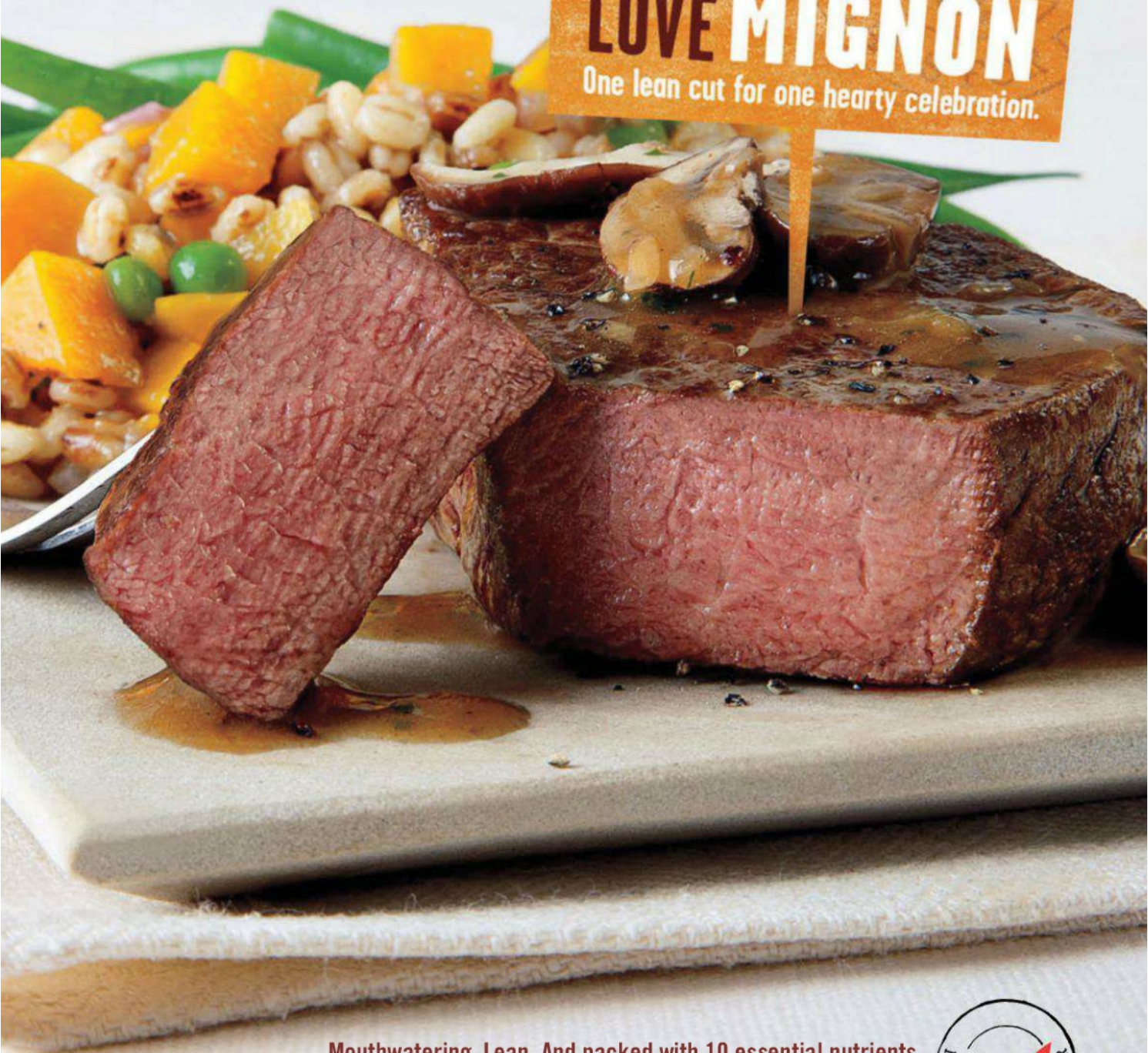


TECH WATCH



# YOU GOTTA LOVE FILET MIGNON

One lean cut for one hearty celebration.

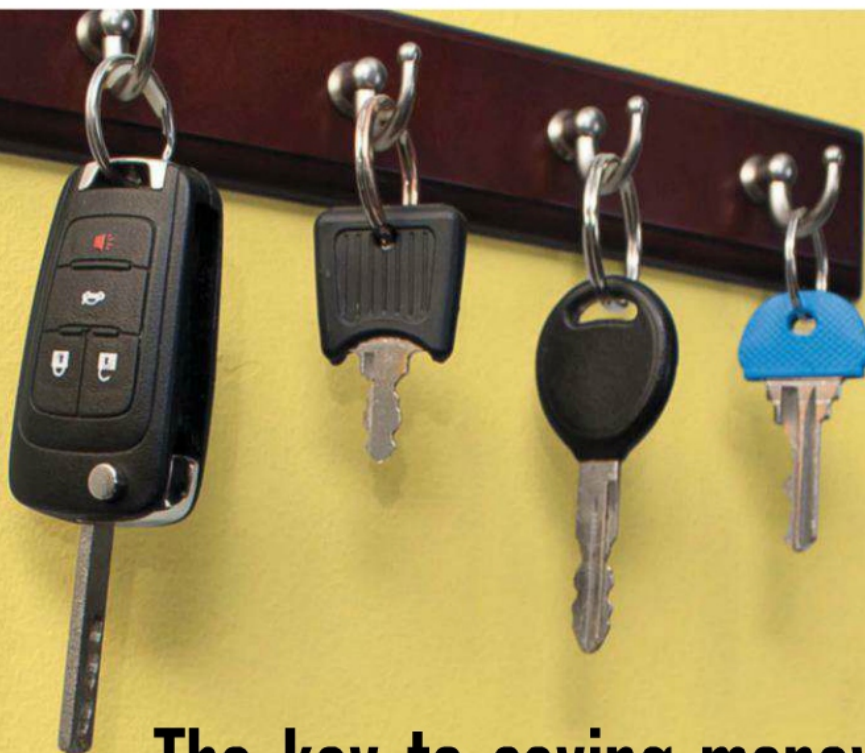


Mouthwatering. Lean. And packed with 10 essential nutrients.  
No matter what the occasion, here's another reason to celebrate.  
Get the "Bistro-Style Filet Mignon with Champagne Pan Sauce" recipe at [BeefItsWhatsForDinner.com](http://BeefItsWhatsForDinner.com).

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# UPGRADE

GEAR

TOOLS

GADGETS



## Rawvolution

Chrome is out. Raw metal is in. Whether you call it brushed steel or satin finish, these days gritty beats slick and homemade is the rage. These products make a statement with cobbled-together motorcycle parts, recycled band saws, and an unfussy feel—proving that too much exposure is actually a good thing.

Oxidized steel gives Schwinn's Corvette Deluxe Cruiser its rough look.

Chicago-based Schwinn marketed the first balloon tire, the B-10E, in 1933. Cruiser mania peaked in the 1950s—and is resurgent today.





## STEEL YOURSELF

Turn your keychain into a toolbox with Kaufmann Mercantile's EDC [Everyday Carry] kit (\$44). The steel tools are light—less than 2 ounces combined—but tough: The U.S. military even outfitted soldiers with the 2-inch pry bar.



### RAT-ROD RIDE

The 26-inch Schwinn Corvette Deluxe Cruiser (\$335) has super-wide 2.1-inch tires and a 45.5-inch wheelbase, and it glides like a classic 1950s-era Cadillac. (There's even a cup holder.) The metal frame oxidizes for seven days before clear-coating. Leave the bike in the rain to give it an even heavier patina, but don't worry: Each 40-pound cruiser spends two weeks in a saltwater bath to test and ensure its durability.

BY JOHN BRANDON

UPGRADE

GLOSSARY

FIXIE

A bike with one fixed gear on the rear wheel, which gives the rider great control but makes coasting impossible: If the bike is moving, so are the pedals. Favored by bike messengers and scruffy hipsters.

### RAW RAKER

Bob Denman hand-forges each 15-inch, 1-pound Red Pig Cultivator (\$36) from recycled 30-foot band saws; the handle is American hickory.



### CUTTING EDGE

At 8 inches long and 3 mm thick, the Spyderco Tenacious Black Blade (\$65) is serrated at the base and super-sharp along the entire edge for versatile cutting. A clip secures the knife to a belt or pocket for easy access on the go.



### AUTO LIGHT

John Ryland designs each Classified Moto Lamp (\$199) from junked motorcycle brake drums, shock absorbers, and transmission gears.

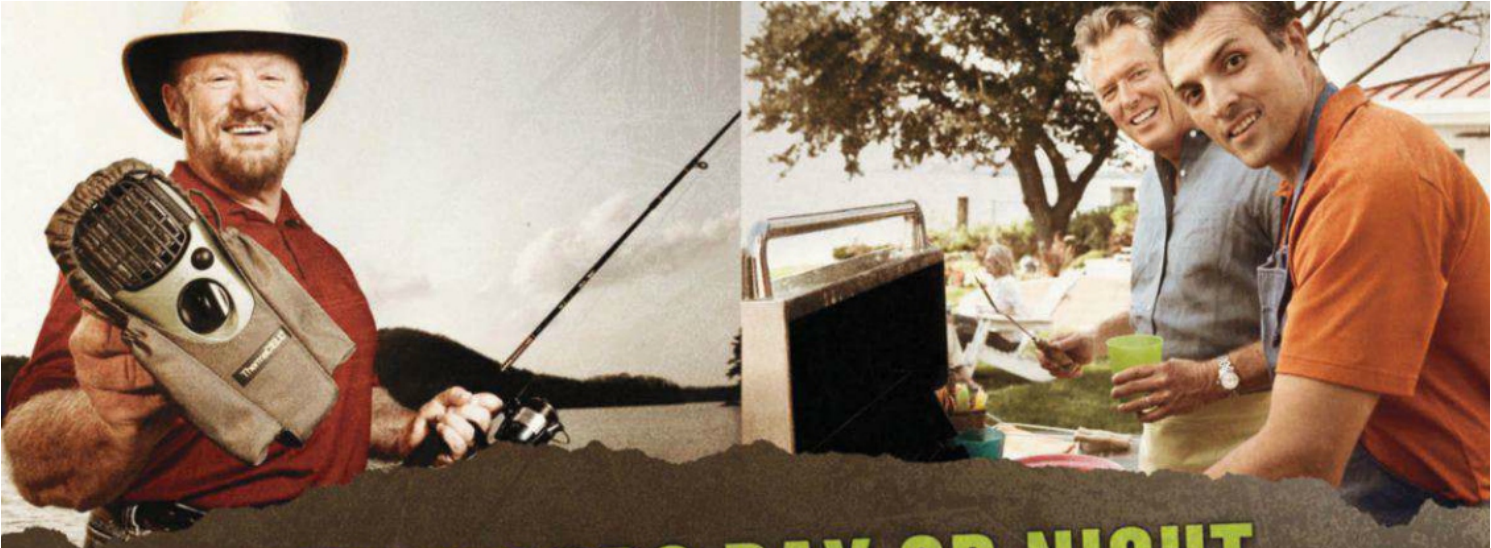


### STURDY SEAT

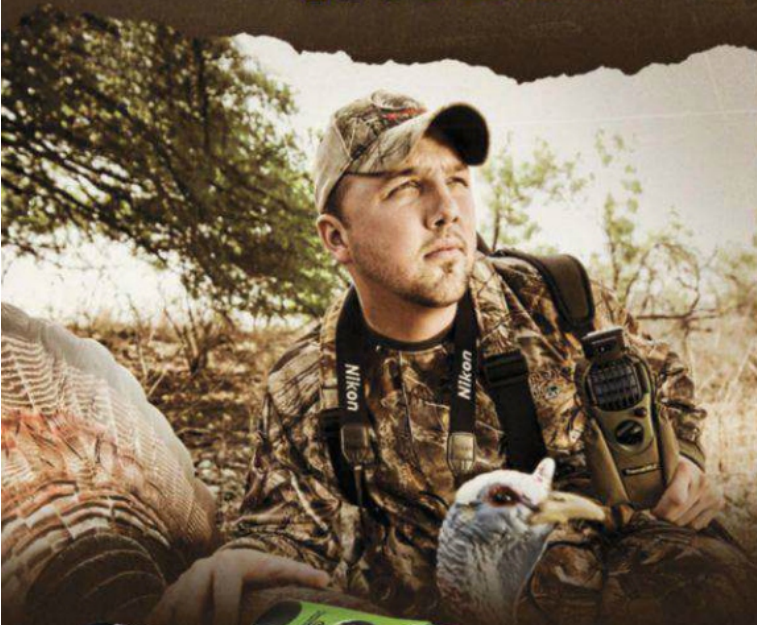
CB2's Flint Barstools (24 inches, \$119; 30 inches, \$129) are pressed out of steel sheets, welded together, ground for smoothness, and "antiqued" in the open air. A clear matte powder seals the stools to arrest oxidation.







# STAY OUTDOORS DAY OR NIGHT WITHOUT A MOSQUITO BITE



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OF PROTECTION



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**ThermaCELL®**



## BACKYARD BLISS

This gear is so cool, it makes the idea of a staycation exciting.

BY JOHN CHASE

### ▼ IGLOO GLIDE PRO COOLER, \$130 TO \$160

You could make do with a polystyrene foam vessel. But investing in this Winnebago-cum-cooler is better for the long haul—for instance, from the back door to that special quiet corner of the yard, where it becomes the anchor of the party. Its handle (based on rickshaw design) and fat, durable wheels take half the effort out of pushing or pulling the fully loaded box. Having had one around the PM office for a few weeks, we must admit that it's tough to resist using it for rickshaw races.



### ▼ CANON POWERSHOT D20, \$350

The 12.1-megapixel D20 is a device for all situations, just as handy on (or under) the high seas as it is beside the kiddie pool. It captures images at depths up to 33 feet; is smash, freeze, heat, and dust resistant; has a built-in GPS; and snaps 1080p HD video.



### ▼ THERMACELL MOSQUITO LANTERN, \$32

An alternative to gaggles and annoying zappers, the TheraCell lantern puts out a 15 x 15-foot cloud of the skeeter-beating chemical allethrin. Department of Defense tests rate it 98 percent effective. That's buzz-worthy.



### ▼ IKEA SOLVINDEN OUTDOOR LAMPS, \$30 TO \$40

Whether hanging from trees or staked along a path, Ikea's Solvinden lights are brilliant. The LEDs inside the spinning blinds juice up on wind and solar power, recharging a battery that lasts 12 hours. They light automatically when the sun sets, and when it returns they begin capturing energy all over again.

### ▼ RENETTO ZERO-GRAVITY HAMMOCK, \$150

Few images connote bliss as effectively as being cradled by a hammock. No trees? No problem. Lightweight and portable, Renetto's Zero-Gravity Hammock (\$150) sets up in seconds and has upright and recline positions for ultimate comfort. Just try not to doze off.



UPGRADE

## PM TEST: iPad vs PRINT

● **IPad Retina Screen**  
Starting at \$500  
264 pixels per inch

VS

● **Canon Pixma MG5220 Inkjet Printer** \$119  
9600 dots per inch



Comparing the new iPad display with a printed page may seem silly (totally different technologies), but the 2048 x 1536-pixel Retina screen makes a good case for using the tablet as a primary device for reading and viewing images. We printed and displayed three photos (a child's face, a canvas tote, a shovel in dirt) and one Adobe Reader file and took a staff vote. —GLENN DERENE

**Photos:** Viewers thought the child's face looked warmer in the print but crisper and

more detailed on the iPad. When printed, the bright canvas bag looked rich, but on the iPad, it was razor sharp. And while the Canon muddled the photo of the shovel in dark soil, the Retina screen brought out all the dirty details. **Winner:** iPad

**Document:** Our test PDF was readable on printed paper, but the iPad won over the test audience. Even at small font sizes, the text on the Retina display was sharper and more distinct. **Winner:** iPad





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Seven  
Corners  
Hardware,  
St. Paul,  
Minn.

UPGRADE

BY BRETT MARTIN

## HARDWARE STORE We Love

**In business since:** 1933

**Clientele:** Contractors, construction workers, DIYers, hobbyists, and woodworkers. Old-home restorers come here for hard-to-find products, such as "spot cord," a heavy-duty rope for repairing broken window sashes.

**Best-selling tool:** The multitool, especially the Fein MultiMaster.

**Claim to fame:** Seven Corners is best known for its deep product lines; e.g., it stocks 173 types of files, including one for replacing horses' shoes. "We actually sell them all—every file has a different use," general manager Chuck Reese says. The store offers more than 1000 hammers, from a \$200 titanium version to mallets with rawhide faces for use on metals and in machine repair.

**What's hot:** Ironically, Seven Corners' most popular product is a book. Its 656-page catalog, designed in-house by Reese, an accountant, and others, is free for the taking inside the store. Complimentary copies are mailed across the country upon phone, email, or fax request. The Machinery Days, held in February, bring the heat to the notoriously frigid St. Paul winters. Tool manufacturers offer hands-on demos of their latest products and have the chance to meet customers face-to-face.

**Oddball product:** The 4-foot pipe wrench draws attention. But the 2-inch-thick Manila rope—used to tie off barges on the nearby Mississippi River—is unique to the store. "It's so thick, we cut it with a hacksaw," Reese says.

### GLOSSARY

#### SQUASH BLOCK

A block of wood cut from a 2 x 4 or 2 x 6 and positioned in pairs next to an I-joist [a wood-framing member shaped like a steel I-beam]. Cut to  $\frac{1}{16}$  inch longer than the joist's height, these blocks bear most of the structural load—and are therefore squashed.

#### ODDS AND ENDS:

36 Phone calls to store per hour

4300 Plumbing items in stock

12' Ceiling height

Chuck Reese,  
general  
manager

349,190

Total products in store: "We ran out of room before we ran out of stuff to stock," Reese says.

What's your favorite hardware store? Email us at [popularmechanics@hearst.com](mailto:popularmechanics@hearst.com).





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## SONY SMARTWATCH, \$149

Sony's SmartWatch lets users access their trove of data, and everything from email to Twitter, from their wrists, which is nice—but is it really that much harder to reach for your phone?



UPGRADE



BY RYAN O'CONNOR

TECH & TOYS

## NERF SUPER SOAKER LIGHTNING-STORM WATER BLASTER, \$25

Liquid combat just went from hand-to-hand to sniper range. The latest Super Soaker is automatic (powered by four AAs), can soak unsuspecting victims up to 25 feet away, and comes with an extra 35-ounce clip.



## AKAI MPC FLY, \$299

One of the few fully realized iPad add-ons, Akai's MPC Fly allows real-time sonic manipulation while serving as a complete production suite. It bridges the gap between studio-quality gear and the DIY producer.



## LOGITECH TOUCH MOUSE M600, \$70

Smartphone-style controls for the PC make the Logitech Touch Mouse M600 a potential game-changer. Sleek, ergonomic, and multifunctional, this wireless controller promises to make your desktop computing as smooth as operating your new phone.



## PHILIPS DS6100, \$180

The problem with most speaker docks is that they're just plain ugly. The Philips DS6100 doesn't have that problem. Its modern design, high-quality speakers, and Mac and PC compatibility make it a winner.



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<sup>1</sup> EPA-estimated 35-mile range based on 94 MPGe (electric); 340-mile range based on 35 MPG city/40 highway (gas). Actual range varies with conditions. Available to order at participating dealers.

2012 Chevrolet Volt. Chevy Runs Deep







BY ERIN MCCARTHY

UPGRADE

## GEAR UP/Kayaking

New user-friendly gear and high-tech garb make aquatic adventure more accessible (and fun) than it ever has been before.

### 1. WHAT THE HULL?

Wider and thus more stable than white-water kayaks, Liquid Logic's Remix XP (\$999) is made with super-linear polyethylene—basically hardcore Tupperware. Use the cave-like rear storage for all your fishing and camping gear.

### 2. KEEP YOUR LUNCH DRY

Protect your supplies with the Watershed Chattooga duffel (\$97), which seals like a big Ziploc bag. Polyurethane-coated nylon forms the rugged shell.

### 3. KAYAKER PHONE HOME

Listen to surf music or take calls while paddling with SealLine's eSeries 8 case (\$20). The headphone wire has a water-tight portal, so your smartphone stays dry even if fully submerged.

### 4. FLOAT LIKE A BOAT

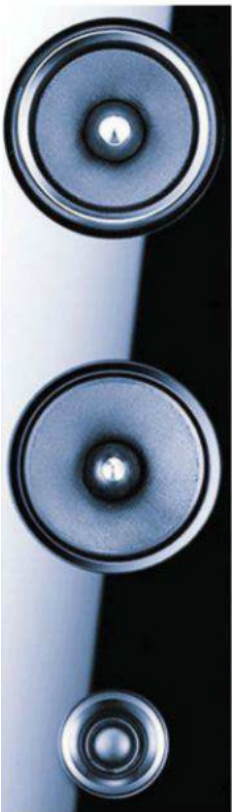
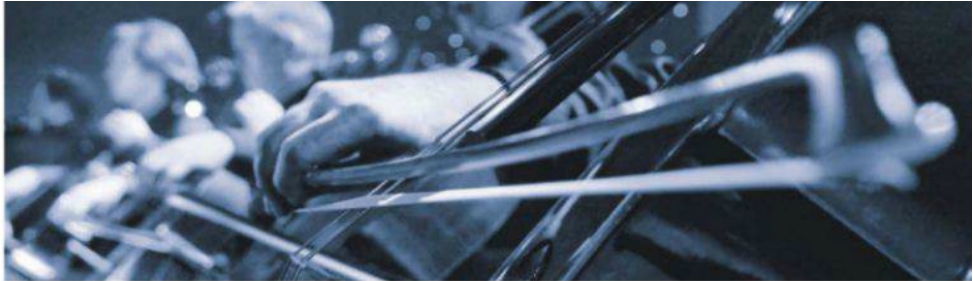
If a kayaker capsizes and nobody's there to hear him, will he make a splashing noise? We're guessing yes. Wear Astral Buoyancy's red Camino lifejacket (\$115) to keep your head above water after that initial dunking.

### 5. EITHER OAR

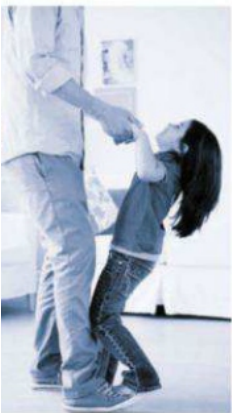
Row like a pro with Bending Branches' Bounce (\$80). The bar is aluminum-coated for strength and has fiberglass-reinforced nylon grips for comfort.







*Samsung HT-E6730W Home Theater*



create wonder



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By combining digital reproduction with analog vacuum tubes you'll enjoy music and entertainment the way they were meant to be heard. The Samsung Home Entertainment System comes with everything you need to fill your home with warm, natural, truly lifelike audio. Plus, the included Blu-ray player gives you access to the Internet, apps and a world of smart content. Experience the future of home entertainment at [Samsung.com/HomeTheater](http://Samsung.com/HomeTheater).

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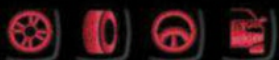
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## SUIT UP / KAYAKING



### HIGH AND DRY

Adjustable neck, cuff, and waist closures keep water out; breathable fabric and ergonomic seaming lend comfort. Immersion Research's Long Sleeve Zephyr Jacket (\$110) rules.



### FIT TO BE TEED

Cotton is so last century. Go with the synthetic stuff, like ExOfficio's Sol Cool Tee (\$34). It wicks away moisture to keep you up to 3 degrees cooler while paddling.



### SHORTS STORY

ExOfficio's comfy, light-weight Nio Amphi shorts (\$30 to \$60) repel water the way Batman's armor rejects bullets. The secret is in the fabric, nylon treated with Repeloff DWR. We don't know what that is—you'll have to ask Alfred—but it works.



### TAKE A STAND

When you're launching or disembarking, your feet need protection from the rocky bottom. Keen's Turia sandals (\$100) do that, plus they're also treated to kill bacteria.

UPGRADE

GEAR UP





'69 Chevy Camaro Z28  
Owner: Leslie Gentry, Actual Carcissist™



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MILES**  
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## BREAKTHROUGH

## The Future of Racing?

THE INNOVATIVE DELTAWING ENTERS ITS FIRST RACE AT LE MANS THIS MONTH. IS IT FOLLY OR BRILLIANCE? BY LARRY WEBSTER

Come June 16, at the start of the 24 Hours of Le Mans sports car race in Le Mans, France, the world will learn whether Ben Bowlby is a genius or a dreamer. Bowlby, a race-car designer with a long and storied résumé, conceived and produced the audacious DeltaWing race car, a machine he claims will dramatically reduce fuel consumption without sacrificing

## DOWN THE ROAD

JUNE

## GET THIS

Aluminum is the most abundant metal on earth. Which is good, because carmakers plan to use a lot of it in the future. PAGE 50

## 3.9 SECONDS

In the time it takes you to read this sentence, the Corvette 427 can go from 0 to 60 mph. PAGE 42

## QUICK QUIZ

Cost to take one lap on the Nürburgring.

- \$35
  - \$350
  - \$3500
- PAGE 56



Acura ILX



Fiat 500 Abarth



Toyota Tacoma TRD T/X Baja Series



Mercedes SL550



Ford Taurus

## BEN BOWLBY, DELTAWING CREATOR

"We can change people's perception of what's possible."



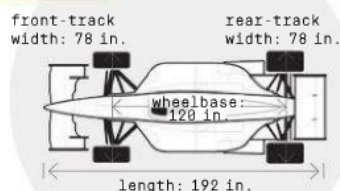
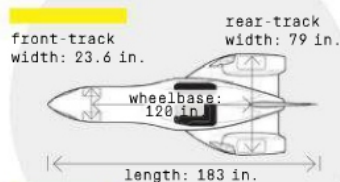


speed. If he's right, automobile racing might once again be a breeding ground for fresh ideas.

Originally conceived as an IndyCar replacement, the 1050-pound DeltaWing is some 500 pounds lighter than an IndyCar and has about half the power (300 hp) and three-quarters of the aerodynamic drag—the keys to the 'Wing's fuel savings. But typically the high aero drag of an IndyCar is a tradeoff for downforce and the corresponding high cornering speeds. An IndyCar can generate some 3.5 g's of lateral acceleration, three times as much as the Enzo Ferrari. The DeltaWing doesn't have the same level of downforce, so how will it maintain cornering speeds without aerodynamic aids?

That's where, according to Bowlby, the rear-weight bias (72.5 percent of the car's weight is on the rear wheels) and the pinched front end come into play. The DeltaWing's front track (the distance between the center of the two front tires) is 23.6 inches, roughly 54 inches less than that of an IndyCar. In a turn, as the car's weight transfers to the outside tires, nearly all of the load is carried by the wide rear axle, where most of the downforce is concentrated. The load on the front tires essentially remains constant. And that formula—at least according to Bowlby—is enough to maintain cornering speeds without relying on

The DeltaWing's hindquarters and cockpit are similar to an IndyCar's, but will that narrow nose stick when the driver turns the steering wheel?



AUTO INTEL

bucketloads of aerodynamic downforce.

The logic seems counterintuitive, but Bowlby remains confident. In December 2008, as Bowlby was formulating the design, even he wasn't convinced of the concept. "Before I made a fool of myself," he says, "I hacked two of my kids' RC cars into mini DeltaWings. After they'd gone to bed, late at night I was driving these things around. And it was like, 'Oh my God, it actually works!' And, yeah, I was surprised."

Many in the racing world remain skeptical. Indy organizers passed on the car. Others, like motorsport entrepreneurs Don Panoz and Chip Ganassi, saw promise and put up funds to keep the project going until the folks at Le Mans provided a berth. Bowlby is building the car at Dan Gurney's All American Racers in Santa Ana, Calif. Gurney is the only American driver to win an F1 Grand Prix in a self-designed car. His backing speaks volumes, but the final verdict will arrive on June 17, 24 hours after the DeltaWing begins circulating on the 8.5-mile Circuit de la Sarthe.

**Wanted**

**2013 CHEVROLET CORVETTE 427**

THE STATS »

**\$100,000 (est.)**  
**505 hp; 7.0-liter V-8/6M**  
**control arms, adjustable shocks**

**14-inch front and 13.4-inch rear vented discs**  
**0-60 mph: 3.9 seconds**

With a rev-happy 505-hp V-8, tires the size of oil drums, a 190-mph top speed, and a folding roof, the Corvette 427 is the lustiest Vette in the line-up. It's also the going-away-party model for the current-generation Corvette [known to gearheads as the C6] before the new C7 debuts sometime next year. Vetteheads will appreciate the number 427, which refers to the engine displacement of 1960s-era Sting Rays, the baddest being the famously over-powered and very collectible 1967 L71 model. That car had just 435 hp, but the 1967 chassis and braking technology wasn't up to the gorilla engine. The latest 427, which uses driveline components from the Z06, suffers from no such drawbacks. Interestingly, the new car's engine, also from the Z06, actually displaces 427.6 cubic inches. But with such highly regarded past models, who can blame Chevy for a little selective rounding?



  
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TEST  
DRIVES

2012 FIAT 500 ABARTH  
PRICE: \$22,000 (EST.)  
AVAILABLE: NOW  
MPG (CITY/HWY): 28/34



2013 ACURA ILX PRICE: \$27,000 (EST.) AVAILABLE: NOW; MPG (CITY/HWY): 22-39/31-38

AUTO INTEL

## ACURA ILX

Acura likes to tout the ILX as fun to drive, but a little touring on hilly Arizona highways made it clear that “fun to drive” applies to only one model—and modestly at that. A little smaller than the TSX, the compact ILX is the luxury brand’s new entry-level offering. New is a relative term here. The front-drive architecture

and powertrains come from the Honda Civic warehouse, including the first hybrid hardware available in an Acura. The basic 150-hp 2.0-liter four-cylinder is paired with a five-speed automatic. Acceleration ranges from ho to hum, with or without using the SportShift paddles. The hybrid system’s electronic management has been tweaked for slightly snappier urban

performance, but the most engaging model is the 201-hp 2.4-liter ILX and its six-speed manual, Acura’s version of the Civic Si. But the ILX trio are far from being rebadged Civics. Chassis rigidity is improved; ride quality has a firmish, Euro feel; the interior is quiet and luxe; the list of standard features is lengthy; and the value proposition stacks up well.

— TONY SWAN

## FIAT 500 ABARTH

F

iat’s retro-chic 500 is easy to fall for, but it drives like an average small car, not some frisky machine tuned for Europe’s twistiest roads. Fiat has fixed that problem by tapping Abarth, its high-performance tuning arm, to upgrade the Fiat’s engine. Under the hood is a new 1.4-liter turbocharged four-cylinder with 160 hp



# WeatherTech®

## Automotive Accessories



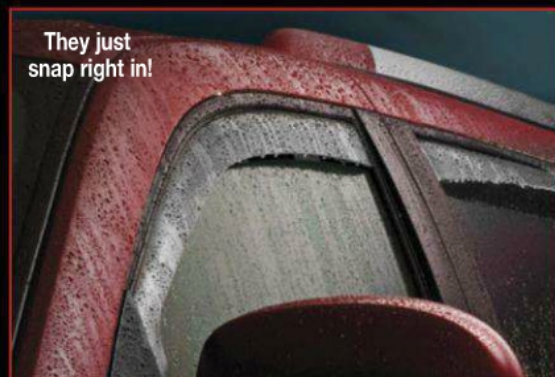
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## TEST DRIVES

and 150 lb-ft of torque. Press the Sport button and you'll get an additional 20 lb-ft of torque at your disposal, as well as firmer steering and a sharper throttle. To handle the power, the Abarth uses heavier-duty drivetrain components, a quicker-ratio steering rack, and a lowered suspension tuned for racetrack play. Although the suspension is stiffer than that of the regular 500, there's a suppleness here. The suspension is tuned for balanced handling, so at the limit the Abarth doesn't plow through the corners like most front-drive cars. You can even use the throttle to adjust the cornering, making for a lively machine—one that takes some skill to master. The Abarth hits 60 mph in about 7 seconds but feels faster, thanks to its 2512 pounds and bantam body. Oh, and the Abarth has an open exhaust; at full throttle it sounds like a squadron of Cessnas are chasing you. It's a fun machine, especially when you see that boost gauge's needle race to the right. — BEN STEWART

2012 TOYOTA TACOMA TRD T/X BAJA SERIES  
PRICE: \$35,255  
AVAILABLE: NOW; MPG (CITY/HWY): 16/21



## TOYOTA TACOMA TRD T/X BAJA SERIES

Toyota has had a very capable and very popular TRD off-road package for its Tacoma pickups since 1998. But according to Toyota, owners have been yearning for a more extreme Tacoma

with high-speed desert capability. That vehicle has arrived as the Tacoma TRD T/X Baja Series—available as a V-6 four-wheel-drive Access Cab or Double Cab short bed in either red or black. Only 750 will be built this year, at a \$4300 premium to the TRD Tacoma. Although it's tempting to describe this truck as Toyota's answer to the Ford Raptor, the Baja simply isn't that radical.

Think of it as a well-executed suspension package. A 1.75-inch lift in the front with TRD springs wrapped around Bilstein shocks increases wheel travel

from 8 inches up to 9.25 inches. In the rear, Tacoma towing-package springs and custom-valved Bilstein remote reservoir shocks offer 10 inches of wheel travel. We got the Baja dusty while four-wheeling at Hungry Valley SVRA in Gorman, Calif. On higher-speed washboard roads, the Bilsteins kept the back of the truck planted and on course, soaking up the punishment with ease. But make no mistake; you do have to check your speed. After all, an extra inch or so of wheel travel doesn't instantly turn this Tacoma into an off-road trophy truck. — B.S.

## Mercedes SL550

The Mercedes-Benz SL has always been a symbol of conspicuous consumption. For 2013, the all-new SL550 continues the tradition. There's a lot to love about the SL. For one, the engineering is beautiful. The frame is 90 percent aluminum—castings, extrusions, sheet metal—the remainder is high-strength steel with a few magnesium bits (see "Parsing Pounds," page 50, for an inside look). The interior is built with a neurotic attention to detail. Of course, it's loaded with electronic driving aids and a high-tech infotainment system that integrates Apple's Siri voice recognition from a paired iPhone. We spent our time with the car driving Spain's southern coast at triple-digit speeds in a bright red 429-hp twin-turbocharged V-8-powered head turner. An indulgent display of wealth, for sure, but that's what you do in an SL. — BEN WOJCYLA



2013 MERCEDES SL550  
PRICE: \$106,375  
AVAILABLE: THIS SUMMER  
MPG (CITY/HWY): 16/25 (EST.)

AUTO INTEL



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## TEST DRIVES



FORD TAURUS

# T

The Ford Taurus hasn't been considered a serious driver's car since the first-gen SHO performance trim debuted in 1989. For 2013, the Taurus receives driving enhancements such as curve control to reduce understeer, more responsive steering, and crisper brakes. Engine options range from the standard normally aspirated 3.5-liter 288-hp V-6 to the SHO's 365-hp twin-turbocharged V-6 (\$39,995), but the big news is a new midrange four-cylinder EcoBoost option that produces 240 hp and 270 lb-ft of torque. Those are impressive numbers for a four-banger and, considering its anticipated 31-mpg highway fuel economy, worth every penny of its \$995 premium. The Taurus still may not be a focused driver's car—it is, after all, a rather large sedan—but the improvements made our afternoon jaunt through the mountains near Portland, Ore., entertaining, thanks in part to the all-wheel-drive system that easily sliced through slush and snow. Ford reports that customers considering the SHO model most frequently cross-shop against the BMW 5 Series—and we believe it.

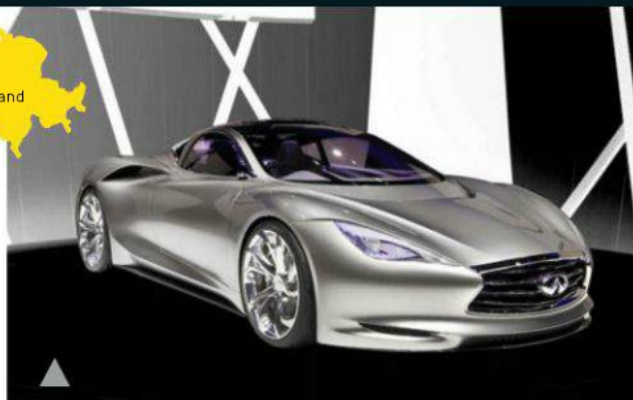
— BASEM WASEF

2013 FORD TAURUS  
PRICE: \$27,395  
AVAILABLE: SPRING 2012  
MPG (CITY/HIGHWAY): 17-21/25-31

AUTO INTEL

## Geneva Auto Show

At the 2012 Geneva Motor Show, carmakers showcased lots of next-generation hybrid technology but mostly quit defaulting to the brown-wrapper eco look. Also, there was an astonishingly hot Lamborghini and an Infiniti we really hope they build.



### INFINITI EMERGE-E CONCEPT

**WHAT:** A hybrid AWD sports car built on a Lotus Evora chassis that can hit 60 mph in 4 seconds.

**SIZE:** Lotus Evora.

**U.S.-BOUND?**

Maybe. **DETAILS:** The Emerge-E busts onto Fisker and Tesla's turf, not to mention steals thunder from Acura's forthcoming NSX.



### TOYOTA FT-BH CONCEPT

**WHAT:** A super-slippery concept that's 25 percent more aero than any Yaris-size car on the road. **SIZE:** Prius v. **U.S.-BOUND?** The tech is—eventually. **DETAILS:** 112 mpg from an Atkinson-cycle 1.0-liter engine and an electric motor; the concept weighs a mere 1800 pounds.

GLOSSARY

● **ATKINSON CYCLE** Extra-long burn makes Atkinson-cycle engines more efficient than typical Otto-cycle motors—but not as powerful.





## LAMBORGHINI AVENTADOR J

**WHAT:** Precisely one topless, windshieldless **Aventador** that, yes, already has a buyer. **SIZE:** Aventadorish but airier. **U.S.-BOUND?** More likely Dubai. **DETAILS:** Forged-carbon-fiber seats may herald a trend because they're cheaper than laying up woven carbon.



## HYUNDAI I-ONIQ CONCEPT

**WHAT:** A swoopy hybrid study with 75 miles of electric range, plus a 1.0-liter three-cylinder engine. **SIZE:** Honda Civic. **U.S.-BOUND?** Not like this. **DETAILS:** It's pretty, but the design hints too strongly of other brands to see it on the streets in this wrapper.



## 2013 MERCEDES A-CLASS

**WHAT:** A Baby Benz to firmly cement the notion that small equals luxury (and eat Mini's lunch). **SIZE:** Ford Focusish. **U.S.-BOUND?** Yes; the hot 300-hp three-door AMG comes first. **DETAILS:** A diesel and seven-speed dual-clutch gearbox may also arrive in the U.S.

"Geneva proves glamour and automobiles will always go together."

— BEN WOJDYLA,  
ASSOCIATE  
AUTOMOTIVE EDITOR



## NISSAN HI-CROSS CONCEPT

**WHAT:** A hybrid crossover with a 2.0-liter four and an electric motor. **SIZE:** Rogue. **U.S.-BOUND?** Perhaps the guts. The sheet metal? TBD. **DETAILS:** This hybrid dances to both FWD and AWD beats, perhaps giving Nissan a cheaper way to hybridize all its crossovers.



## 2014 AUDI A3

**WHAT:** The third-gen A3. **SIZE:** Slightly larger than the 2012 A3. **U.S.-BOUND?** Yes, but sans some body styles, and it's still TBD whether the U.S. will get the 300-hp S3 or the 408-hp RS3. **DETAILS:** The showcar had an infotainment screen with iPad-like swipe and drawing features.



## PARSING POUNDS

### TO SAVE WEIGHT (AND FUEL), AUTOMAKERS ARE TURNING TO ALUMINUM.

BY LINDSAY BROOKE

For every 150 pounds of weight removed from a vehicle, fuel economy increases by roughly 1 mpg. There's no single way to reduce mass, so future vehicles will ride on a mix of high-strength steel, aluminum, magnesium, and new composites. Among these, aluminum has the greatest potential to replace steel. But there's a problem: Aluminum is about two-thirds the weight of steel at an

equivalent strength, but it's not as stiff. That means that some sections of aluminum autos must be built thicker to keep those vehicles as rigid as their steel counterparts.

The latest aluminum strategy can be seen on the new Mercedes SL. The SL has aluminum castings, extrusions, and stamped sheets. The SL also uses strong extruded-aluminum panels rather than simple sheet metal to form the floor. This greatly strengthens the floor—important in a roadster with no fixed roof.

Mercedes estimates that the new SL's structure is about 300 pounds lighter than the previous model's, with 20 percent greater rigidity. That's a considerable improvement to be sure, but on average, aluminum costs three times as much as steel by weight. Although the cost is offset somewhat by manufacturing savings, widespread aluminum use is, for now, best suited to pricey machines such as the \$100,000 SL. But plenty of lower-cost cars, like the Cadillac ATS and Audi TT, employ the material sparingly to cut pounds.

AUTO INTEL

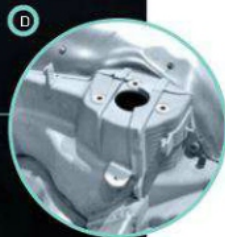
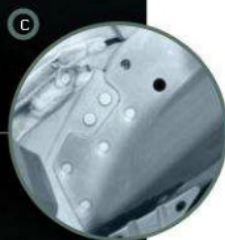
#### AUTO TECH



**Audi TT** The sporty TT has the same main structure as the VW Golf. Engineers replaced many of the Golf's steel panels with aluminum to shave weight while retaining the cost-saving commonality.



**Cadillac ATS** A welded aluminum engine cradle and cast strut towers reduce overall weight and lighten the front end, which aids handling. Also, the ATS has magnesium—stronger, lighter, pricier—engine mounts.



2013  
MERCEDES-BENZ  
SL

#### A Side Rails

Aluminum extrusions are like pipes with added internal bracing. They run along the sides of the car and are welded to castings near the wheels.

#### B Hood

An old-time hot-rod trick: What's lighter than a hole? These dimpled cut-outs are raised, giving the flat panel topography—and stiffness.

#### C Windshield Frame

Steel is used here to provide rollover protection and thinner pillars for outward vision. The frame is riveted and bonded to the aluminum structure.

#### D Shock Tower

Aluminum castings are connecting points used in high-load areas such as the shock towers. They're thicker at high-stress areas.





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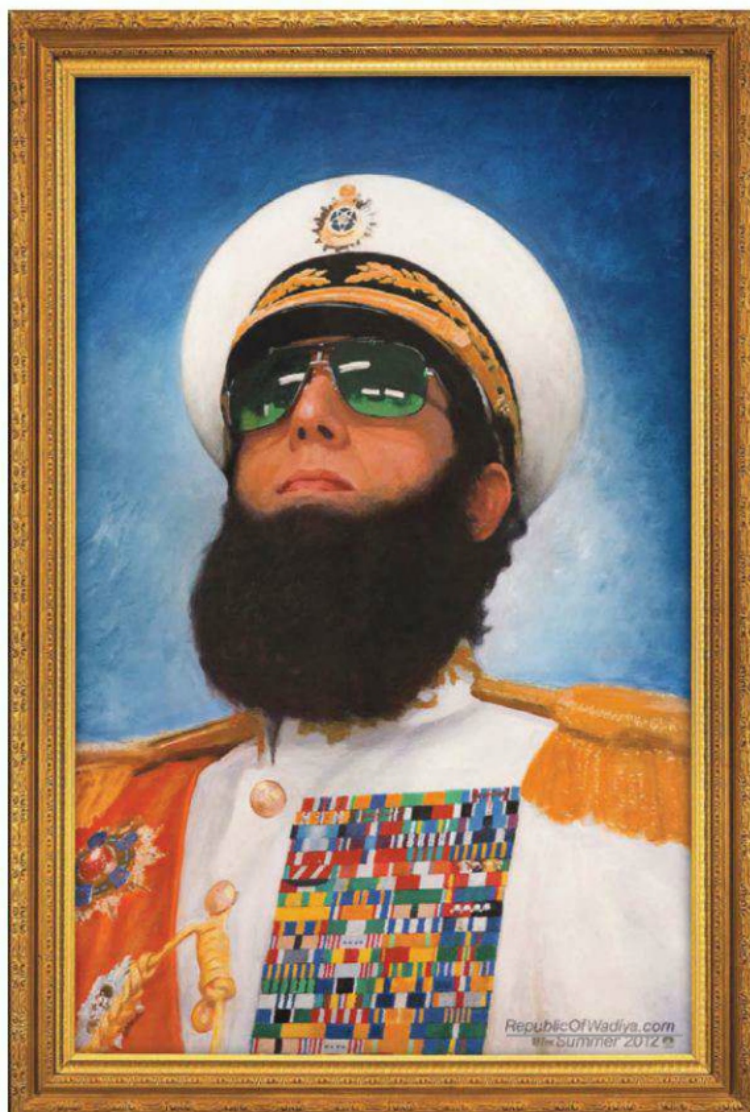
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Of the nearly 1800 designs submitted, the Stack was  
one of 27 selected for Michelin's final showcase.



What the #@%\*?

## MICHELIN CHALLENGE DESIGN: Stack Concept

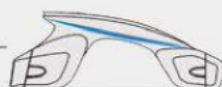
Established in 2002, the Michelin Challenge Design asks designers and engineers to address a new theme each year. For 2012, the theme was City 2046, and designers had to create a personal ground-based vehicle able to transport two to 10 people at a time in one of five cities: Los Angeles, Paris, Rio de Janeiro, Shanghai, or Mumbai.

As the name implies, Stacks are meant to nest in groups for compact storage. The idea was conceived by a team of six digital-design students from the DSK ISD International School of Design in Pune, India. The group designed their vehicle for Mumbai, where they estimate as many as 76 million people will live by 2046. Stewart Reed is the jury chairman for the Michelin Challenge Design. "While the concept of stacking cars is not new, this was particularly well-articulated, with very sophisticated form development," he said in an email.

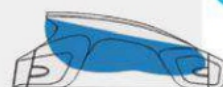
The Stack is based on a shared-use model. A private company would maintain the fleet, and when you need a ride, you take the first car in the stacked lot. The vehicle's settings would then be personalized via data stored on the company's servers. Think of it as cloud commuting. — ANDREW DEL-COLLE

### MICHELIN CHALLENGE DESIGN

AN ADJUSTABLE  
CARBON-NANO-FIBER  
PASSENGER  
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OR CONTRACTS  
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THE MODE.



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VEHICLE STACKING  
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AUTO INTEL



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# 26

Euros it costs (about \$35) to take one lap around Germany's legendary Nürburgring. For a mere 1350 euros (\$1791), you can have the course all to yourself for an hour.



# 800

Amount of fuel per year [in tons] Nissan says it will save with its new Leaf shipping vessel, the *City of St. Petersburg*. Engineers designed the 21,000-ton ship with a blunt, round nose to reduce wind resistance by up to 50 percent. The ship can transport 2000 Leafs from factories in the U.K. and Spain to northern Europe and Russia.

AUTO INTEL

# \$50,000

Winning pot for the new X Ceedingly Bad Idea Prize at 24 Hours of LeMons, a Le Mans spoof. The sum goes to the first team to build a driverless vehicle that wins a race. The car can't cost more than \$500, but there's no price limit on making it autonomous. Seems like an easy win for Google.

## THE LOT

1997 to 1999

**Porsche  
Boxster**

**Price Range**

\$6500 to \$11,000



Porsche charm at a workingman's price.

### Why It's Cool

- It's cheaper than the 911 but with an engine mounted in front of the rear axle—the location Ferdinand Porsche himself deemed optimal for crisp handling. So the Boxster's no 911 lite; it's the best driver's car in the lineup.

### What It Says

- I couldn't afford a 911.

### Watch Out For

- Some cars had faulty intermediate shaft bearings. Those don't go down alone: When they fail, the resulting mayhem kills the engine too.

### Why You Want It Anyway

- The flat-six howl hides the rather meager 201 hp, and the brakes are heroic. It's only a few grand more than a used Miata yet avoids the chick-car baggage.

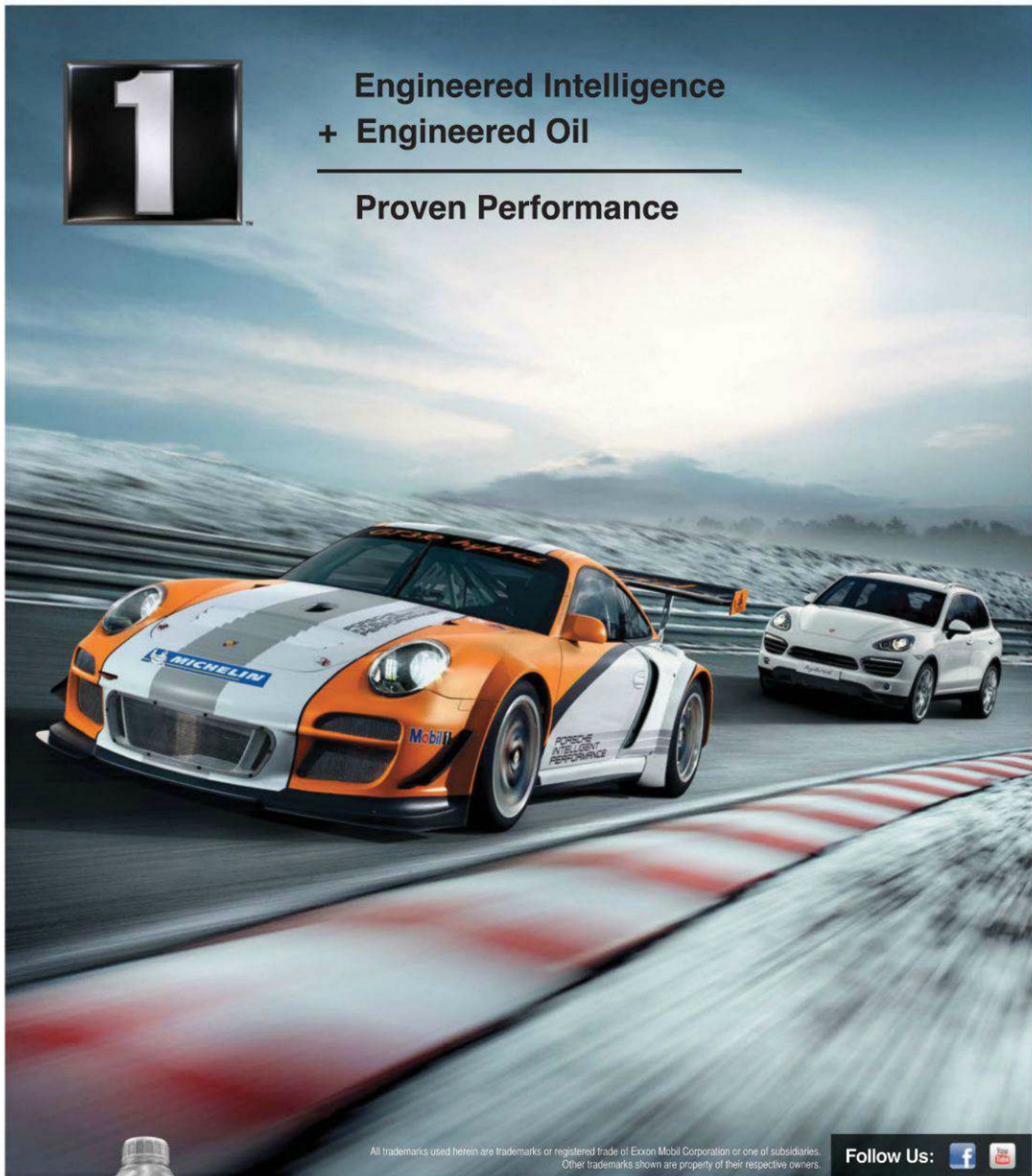




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## Man With a Plan

**"DETAILING A MOTORCYCLE IS ABOUT MORE THAN TECHNIQUE. GETTING A CLEAN MACHINE IS ZEN-LIKE."**

BY BRADY WALKER,  
AS TOLD TO WOOK KIM

○ **Owning a classic bike is like dating** a woman who's out of your class—very high-maintenance and demanding of your time and money.

○ **I'm in with a tight group of enthusiasts** who make up the Venice Vintage Motorcycle Club on the California coast. Bikes consume most of my time outside of my day job as an audio engineer making promos for

California gleaming: Brady Walker of the Venice Vintage Motorcycle Club sits astride the [very clean] '68 Triumph he inherited from his father.





# Check Engine Light?



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ELover08

"I've been getting a check engine light that comes and goes. I connected my iPod and it found a problem with one of the oxygen sensor heater circuits. It turned out to be a poor electrical connection. I was able to **repair it myself and avoid a hefty mechanic's bill!** I would say it paid for itself right out of the box!"

Tom7601



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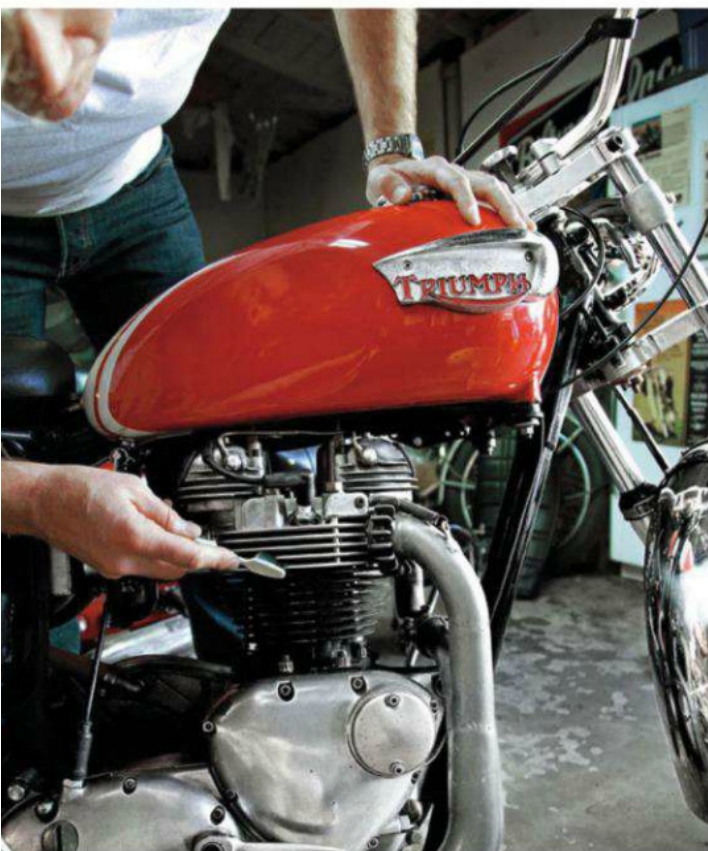




Fox Broadcasting. I'm a really organized person. That's essential in my work, and it's also why the club relies on me to plan our events. I like the nitty-gritty logistics, such as getting permits. To me it's not tedious; attending to the little things is satisfying.

○ **Maybe that's why I like detailing.** Everyone in the club

## "RESPECT THE MACHINE" MEANS YOU ALWAYS KEEP ITS POWER IN MIND. A SAFE BIKE IS PRIORITY NO. 1; AESTHETICS ARE A CLOSE SECOND.



The fins on the cylinder barrels help to cool the engine. They also collect more dirt than a doormat.

likes a clean bike, except maybe Bubbles. He has a Triumph that would turn into a big bag of parts if he were to wash it.

○ **Vintage biking is not a utilitarian subculture.** What people wear, how they wear it, their tattoos—part of being in this scene is about sharing a particular aesthetic. There are other types of motorcyclists who could give a rat's tail about keeping things tight and neat. I can respect that. But just the same, I'm keeping my kit clean.

○ **I own four bikes: an '83 Suzuki GS1100E,** a 2003 Yamaha YZF-R1, and a 1979 Yamaha SR500 for racing. The fourth is my vintage ride, a '68 Triumph TR6C Dual Sport Custom. It was my father's. He crashed it—nothing serious, but after that it sat in our garage in pieces. When I finished high school, my parents asked me what I wanted for graduation. I said, "Get the Triumph running!" It's been a love affair ever since.



### DRENCH

When the bike is cool to the touch, gently hose off mud and grime. Some guys skip this step, but I can't, since I run my bikes off- as well as on-road.

### DEGREASE

Remove oily residue with a degreaser like Gunk; use brake cleaner for really nasty buildup.

### CLEAN THE CHAIN

Work a solvent-soaked rag along the chain, removing oil and debris while also straightening out any kinks.

### SOAP 'ER UP!

Clean surfaces with a very mild dish-detergent solution. Use a toothbrush to get into hard-to-reach areas.

### BUFF

Polish all metal and painted surfaces. Apply paste sparingly or you'll waste a lot of time removing chalky residue.

○ **I take a lot of crap for treating her** like a trailer queen, which is a pretty motorcycle that's always in tow. But recently I've gotten past my OCD of over-protection by actually riding her. She's still gorgeous but a heck of a lot more fun!

○ **I try to obey the rules of the road—really, I do.** But sometimes it's hard. I can peel through gears and get to speed faster than most cars. It's easy to get reckless with that kind of power in your hands.

○ **Still, you have to respect the machine.** You always keep its power in mind. Leave your ego at the curb or bad things could happen. In my opinion, respecting the machine means also taking care of it. A safe, well-maintained bike is priority No. 1; aesthetics are a close second.

○ **Some guys spend a whole day** on a detailing job. You get in the zone and time evaporates. But I can detail my bike in an hour if I put my mind to it.

○ **Yes, I own a car. And yes, I can make it** as clean and shiny as my bike. Well, maybe for a few days out of the year. **PopMech**





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*The austere North Dakota prairie is the unlikely center of one of the biggest oil booms in decades. But will drilling here and in other domestic oil patches help the country move closer to the elusive goal of energy independence?*

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COVER STORY

# The **BIG** PLAY

BY JAMES VLAHOS • PHOTOGRAPHS BY BENJAMIN LOWY

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*Pumpjacks near Tioga, N.D., pull crude from the Bakken Formation. In 2012, output from the play—the industry term for a hydrocarbon-bearing stratum—may turn the state into the nation's second-biggest producer, behind Texas.*





*I am holding a rock that looks like a hockey puck, one so solid that a slap shot would result in a busted stick. It's 360 million years old. Long before dinosaurs roamed the earth, zooplankton, algae, and sand accumulated on the bottom of a Devonian sea. Heat and pressure transformed the sediments into a layer of shale, which is now buried 2 miles beneath the windswept prairies of the northern Great Plains. This stratigraphic layer is called the Bakken, and it is where the rock in my hand had rested, until very recently, in mute, stony peace. I'm standing inside one of the command posts for the Harvey, an oilwell*

in the North Dakota section of the Williston Basin, squeezed shoulder to shoulder with men in red jumpsuits. We're watching Jared Edverson, who sits at a control panel, and waiting for him to trigger explosives.

These days, detonations of all kinds—social, economic, and pyrotechnic—are “Rockin’ the Bakken,” as a popular local T-shirt puts it. The Bakken has inspired thousands of fortune seekers to head north in a modern-day version of the Klondike Gold Rush. It is responsible for minting millionaires but also for costing people their homes and, occasionally, their lives in oil rig accidents. It has contributed to the fear in some quarters that an environmental apocalypse is nigh, and the hope in others that the Americas, not the Middle East, will one day be the epicenter of the global energy supply. “Five years ago, you tell people you are working in North Dakota, and they would be like, what are you talking about?” says LeeDon Wiseman, the Harvey well’s lead consultant.

“Five years ago?” says a co-worker. “Last year even.”

“Now we’re on every world map there is,” Wiseman continues. “Bakken. It’s an explosion. Worldwide.”

In 2001, North Dakota wells produced 31 million barrels of oil, less than 2 percent of which came from the Bakken. Last year the state generated a record 152 million barrels, and more than 80 percent of it was Bakken derived. For 2012, North Dakota’s output is projected to surpass that of California (196 million barrels) and possibly even that of Alaska (209 million barrels) and to lag behind only Texas (533 million barrels). Estimates for the total amount of oil that could be recovered from the formation range wildly, from a few billion barrels or less to exponentially more. In an unpublished but nonetheless widely referenced paper from 2000, Leigh Price of the United States Geological Survey estimated that 200 billion barrels of oil could ultimately be extracted.

The Bakken crude is exceptional, light and sweet. But it’s difficult to recover. The formation is broad, sprawling over 25,000 square miles beneath North Dakota, Montana, Saskatchewan, and Manitoba, and skinny, reaching a maximum thickness of only 160 feet. What’s more, the rock is dense, averaging 5 percent or less porosity, which means that 95 percent or more of the rock consists of just that—solid rock, rather than open pores that can hold oil. (Conventional oilfields, like Saudi Arabia’s Ghawar, have porosity of up to 35 percent.) Russell Rankin, a regional manager for Statoil, a

multinational energy company and one of the owners of the Harvey, gestures toward my core sample. “You see that rock and say, ‘It looks like concrete,’” he says. “How do you get oil out of that?”

Part one of the answer is to employ horizontal drilling, which oil companies began trying here in the late 1980s. A couple of weeks before I arrived at the Harvey, the workers started by drilling straight down, just as they would traditionally. But then, as the bit approached the 2-mile depth, the workers guided it on a graceful, 90-degree curve into the Bakken. From there they drilled horizontally for another 2 miles, maximizing the well bore’s access to the thin geological layer.

Part two of the answer is hydraulic fracturing, another technological innovation. In the command-post truck, Edverson stands by to initiate the first step in that process. A man’s voice crackles over a two-way radio. “We’re at 14,910 feet, you good?”

“I’m good,” Edverson replies from his seat in front of the control panel. He turns a dial to amp up the electrical charge he’s about to unleash, lifts a red protective cover, and reaches for a toggle switch labeled SHOOT.

**THE BAKKEN BOOM IS THE** biggest in North Dakota history, but it isn’t the first. Just ask Kathleen Neset. A New Jersey-bred, Brown University-educated geologist, Neset arrived at the height of the 1979 gas crisis. Prices were soaring and oil companies were thirsty for North Dakota



crude, even though it was costly to extract. Neseet met her future husband, Roy, while they were working on a rig near Bismarck, and the couple launched a drilling and geological consultancy to help drillers locate the most oil-rich rock. But then the gas crisis ended, oil prices crashed, and “the state went from 146 active drilling rigs in 1981 to basically zero,” Neseet says.

In the wake of the bust, Roy, Kathleen, and their two sons supported themselves mostly by working on their family farm, which had been homesteaded a century earlier by Roy’s Norwegian ancestors. But then, in the late 1990s, their oilfield business began climbing again, and since 2008, it has skyrocketed. Today, the Neseet Consulting Service has crews working on nearly half of the state’s 200-plus active drilling rigs, and Kathleen Neseet is one of the best-known women in the state’s oil industry.

On a cold, clear day in February, Neseet takes me to visit the farm, just outside the town of Tioga. After driving between golden fields of durum wheat, we reach a small hilltop, where a windbreak of ponderosa pines opens to reveal a white farmhouse. Oil was first discovered in North Dakota only a dozen miles from here, in 1951, and behind the Neseet farmhouse is a well that was drilled a few years later. Long since abandoned, the rusty artifact is a reminder that people have been trying to suck oil out of North Dakota for six decades, and its presence raises an obvious question: Why has it taken until now for production to kick into overdrive? “Well, we always knew the oil was here,” Neseet says. “But to get it out of the ground, we had to wait for the technology to catch up.”

It was the chance to see the new technologies in action that had brought me to the Harvey well, about 50 miles southwest of

## FRACKING THE BAKKEN

1

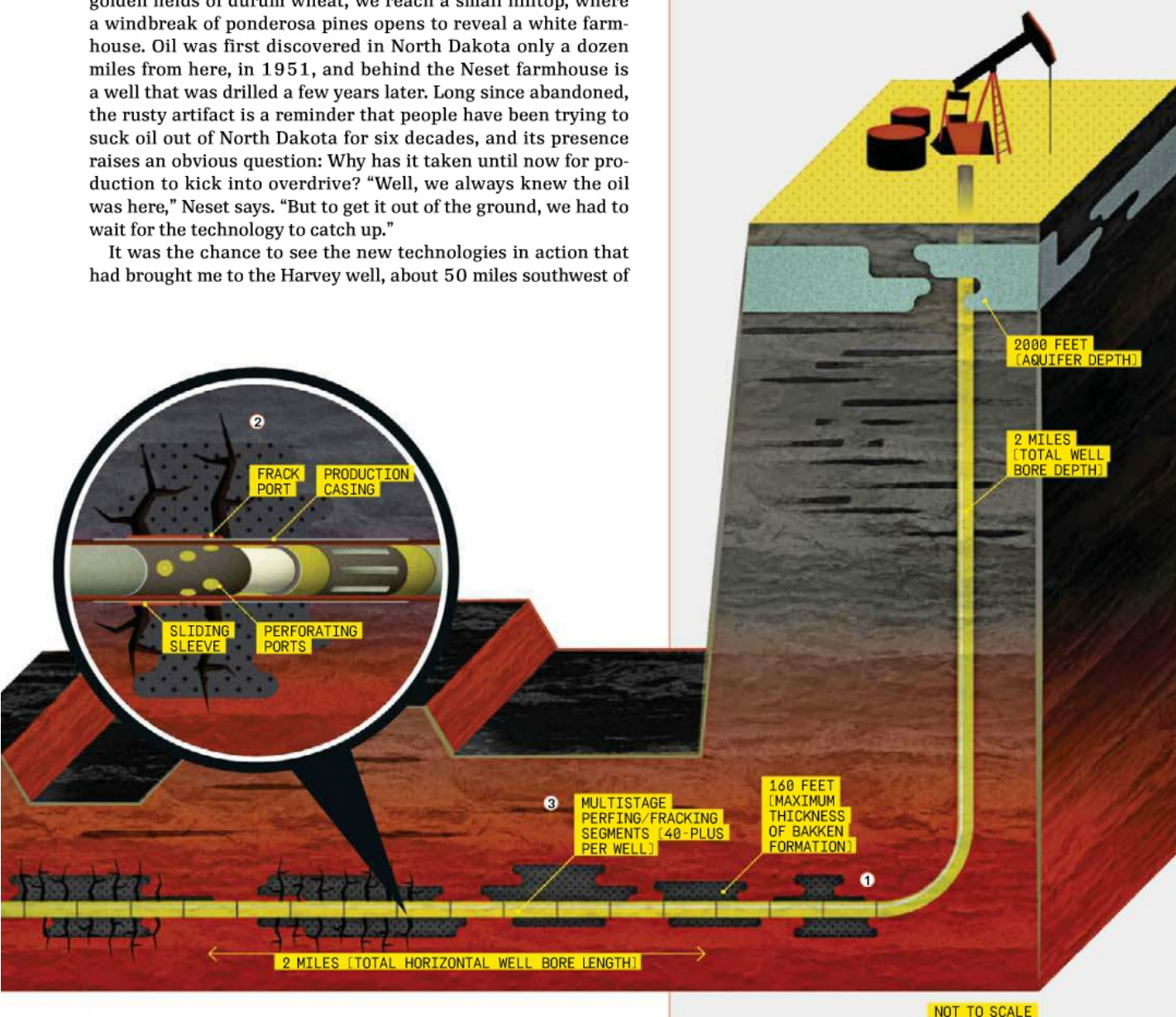
North Dakota’s Bakken Formation is a layer of dense, oil-bearing rock found at a depth of about 2 miles. To tap it, oil companies drill to the hydrocarbon-rich stratum, then curve the well bore 90 degrees so that it runs horizontally through the thin, irregular formation.

2

Hydraulic fracturing, or fracking, typically frees oil by cracking rock with high-pressure bursts of water, sand, and chemicals. Tight rock in shale-oil plays like the Bakken requires multistage fracking to maximize oil recovery.

3

In multistage fracking, engineers perforate short segments of the production casing independently. This allows them to concentrate the hydraulic assault, creating longer cracks that allow more oil to flow to the well.





Neset's farm. As I look on, Edvenson's fingertips find the shoot switch and flip it, triggering explosive charges 2 miles down in the Bakken layer. They blast a series of cracks that extend outward from the well bore and into the surrounding rock. This step—called perforating, or perfin—doesn't release much oil; the cracks are only a few feet long and finger width. Rankin says perfin creates zones of weakness, and the next step is to attack them.

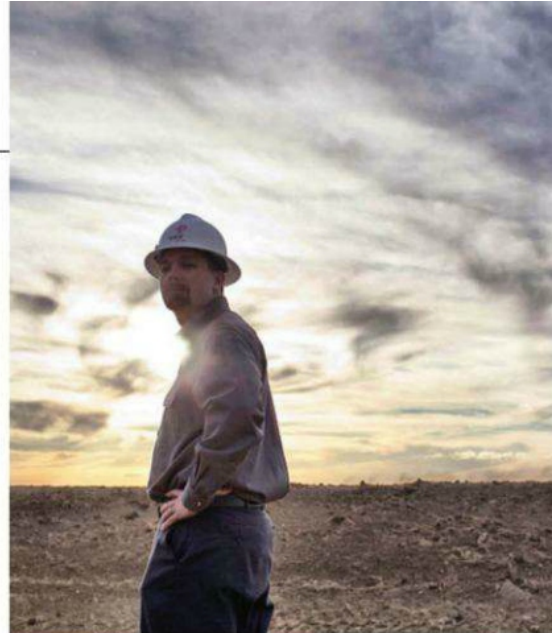
Rankin and I walk a few dozen yards to the frack van for another well, the Kari, which has already been perfin. Inside, well-site consultant Scott Bell shows me a sample tub of fracking solution, a beige goo consisting mostly of water and sand as well as chemicals that inhibit bacterial growth and enhance viscosity. Thousands of gallons of the stuff are being pumped through hoses and deep into the well. The fracking solution then surges into the perforations, driving the cracks several hundred feet outward from the bore. Bell and Rankin monitor the assault on a computer screen, watching as the pressure climbs to 6500 psi. "She likes it, she likes it," Rankin says.

At this point, if Bell simply shut off the pumps, the cracks would snap shut again. Instead, his team changes the mixture of the fracking solution so that it carries tiny ceramic beads, called proppant. The proppant gets packed into the fractures and stays there, holding them open so that oil can flow freely to the bore.

Until a few years ago, wells were perfin, then fracked, in a single pass. Rankin calls this the Hail Mary approach. Now well pipes are subdivided into 40 segments or more, each of which is perfin and fracked in isolation, maximizing the effectiveness of the hydraulic onslaught. "Multi-stage fracking has revolutionized the Bakken," Rankin says.

The new techniques have given rise to the current Bakken boom, but there are no guarantees that it, too, won't go bust like those of the past. Even when coaxed with the latest techniques, the formation is stingy about releasing hydrocarbons; for example, while production from a new well in a conventional oilfield declines about 5 to 8 percent per year, the output from Bakken wells declines 65 percent after the first year. Ultimately, even if the most wildly optimistic estimate of Bakken oil reserves is correct—around 200 billion barrels—the amount of oil that can actually be recovered may still be only 10 billion barrels or less.

The other uncertainty is the price of oil. Rankin says that



*These days, detonations of all kinds—social, economic, and pyrotechnic—are "Rockin' the Bakken" in North Dakota.*

drilling, which is more costly in the Bakken than it is in conventional fields, will be profitable even if prices drop to \$60 a barrel. The Bakken play may thus sound like a safe bet, with prices currently topping \$100 a barrel. But as inflation-adjusted data from energy analyst James Williams of WTRG Economics indicate, oil prices

## CONTINUING PAIN AT THE PUMP

Oil production is rising in the U.S. and Canada, and American consumption is at an 11-year low. Yet gas prices have not receded. Here's why. *Reporting by Joe Pappalardo*

### GLOBAL COMPETITION

Steady demand from China and other booming economies is one reason why the price of crude oil reached record levels in early 2012. And, according to Amy Myers Jaffe, director of Rice University's Baker Institute Energy Forum, "Crude oil price is the single biggest influence on U.S. retail gasoline."

### OVERSEAS UNREST

The price of crude is extremely sensitive to market disruptions. For example, when trouble looms in the Middle East, European nations seek more reliable suppliers, who then demand higher prices, which drives up costs for U.S. refiners. "When people talk about attacking each other in the Middle East," Jaffe says, "it lifts the price of oil."

### WEAK INFRASTRUCTURE

The increase in North American production has overwhelmed domestic shipment and storage infrastructure. The inability to move crude efficiently around the U.S. has made some refineries reliant on Middle Eastern and African suppliers and therefore vulnerable to price spikes. Those increases are passed on to consumers at the pump.

### REGIONAL STANDARDS

Even if American refineries all had equal access to domestic crude, regional prices would still vary because of differences in city and state clean-air standards. These regulations lead to local production of boutique gasoline, which drives up prices. In general, big cities have tougher standards, so urban drivers pay a bit more than rural ones.





*This rig near Williston, N.D., drills down 2 miles to the Bakken Formation and then horizontally through the pay zone. Opposite: Statoil's Russell Rankin surveys a drill site outside Williston.*



## MOVING THE CRUDE



A boom in oil production doesn't mean much without a robust infrastructure to deliver the crude to refineries. Here's how oil from North Dakota's Bakken moves across the country—and to a gas pump near you.

**1) NORTH DAKOTA**

Most of the wells in northwest North Dakota aren't linked to the area's eight major oil pipelines. Instead, tanker trucks haul crude to pipes and rail—this puts about 2000 trucks daily on North Dakota roads. The state allocated \$307 million for oil country roadwork in 2011, mostly to build bypasses and repair highways. The region will spend another \$605 million by 2013.

**2) THE MIDWEST**

Pipelines take crude to Flanagan, Ill., and then to a major storage area in Cushing, Okla. But the boom—nearly 97 million barrels more in 2011 than in 2007—is overwhelming the tank farm. With the pace of this growth expected to continue, energy companies are adding pumping stations and widening pipes (in one case from 30 inches to 36). One plan will increase the flow by 120,000 barrels per day within two years.

**3) THE GULF**

There are not enough pipelines available from Cushing to Gulf refineries to satisfy the demand. Pipelines are being built or improved—for example, owners of the Seaway Pipeline from Cushing to Houston are adding a twin 30-inch pipe, doubling capacity by 2014 to 850,000 barrels per day. St. James, La., is expanding facilities to move that crude to refineries via rail.

**4) THE EAST**

There are no pipelines that connect Bakken fields to East Coast refineries. Tanker trains running eastward across Canada offload oil in Albany, N.Y., where it's transferred to river barges and delivered to a Sunoco refinery in Philadelphia. Trains also supply remote customers, such as the Continental Refining Co. in Somerset, Ky.

**5) THE ROCKIES**

Pipelines take crude to a hub in Guernsey, Wyo., and then to refineries in Salt Lake City. Rocky Mountain refineries' crude comes only from Canada, Colorado, and North Dakota, so these gasoline makers can take full advantage of depressed Cushing-based prices. In early 2012 oil gridlocked at Cushing sold for around \$20 less per barrel than Middle Eastern oil—and drivers in the Rockies benefited.

**6) THE WEST**

BNSF Railway trains haul shipments of crude from the Bakken west to Washington state and south to refineries in California. With Canada building new pipelines from the Alberta oil sands to terminals on the country's west coast, the question remains whether Canadian crude will be shipped to China or south to the U.S.

have remained below \$60 a barrel for most of the years since World War II. If prices tumble back down toward their long-term historic norms, Neseet may need to return to her crops once again.

E

**ENERGY BLOGGER**

Ken Paulman was surfing the Web last year when he came across a time-lapse video, recorded from the International Space Station, that took viewers on a soaring journey over the earth at night. A geography buff, Paulman says he was puzzled when, in what should have been a blank spot on the U.S. map, the lights of an enormous "mystery city" spun into view. He realized to his surprise that he was seeing the Williston Basin.

At the heart of the boom, the city of Williston, N.D., has grown from 12,500 residents a decade ago to nearly 20,000. Driving around town, I'm flanked by semis hauling water, sand, and oil, and I pass intersections where city workers are stringing up new traffic lights. The Walmart is jammed with shoppers, and it takes half an hour for my order to come up at McDonald's. Unemployment is around 1 percent, and Williston mayor Ward Koeser estimates that there are more than 3000 local job openings. The work isn't just out on the rigs, either; the newcomers need places to eat, shop, live, and blow off steam. Melissa Slapnicka, the co-owner of a strip club called Whispers, recently boasted to CNN that "my best girls would rather dance here than in Vegas because they make more money here."

Civic infrastructure, though, hasn't kept up, Koeser and other local mayors say. Schools and hospitals are crowded, sewage systems overwhelmed, and police flooded by service calls. The numbers of burglaries and violent crimes are on the rise. The most acute problem is the housing shortage, despite all of the hotels and condo complexes being built. Jacob Brooks, managing editor of the *Williston Herald*, says that many apartment

Nearly three times the amount of crude is shipped from North Dakota by pipeline than by rail, but trains are increasingly being used to bypass distribution bottlenecks.

2010

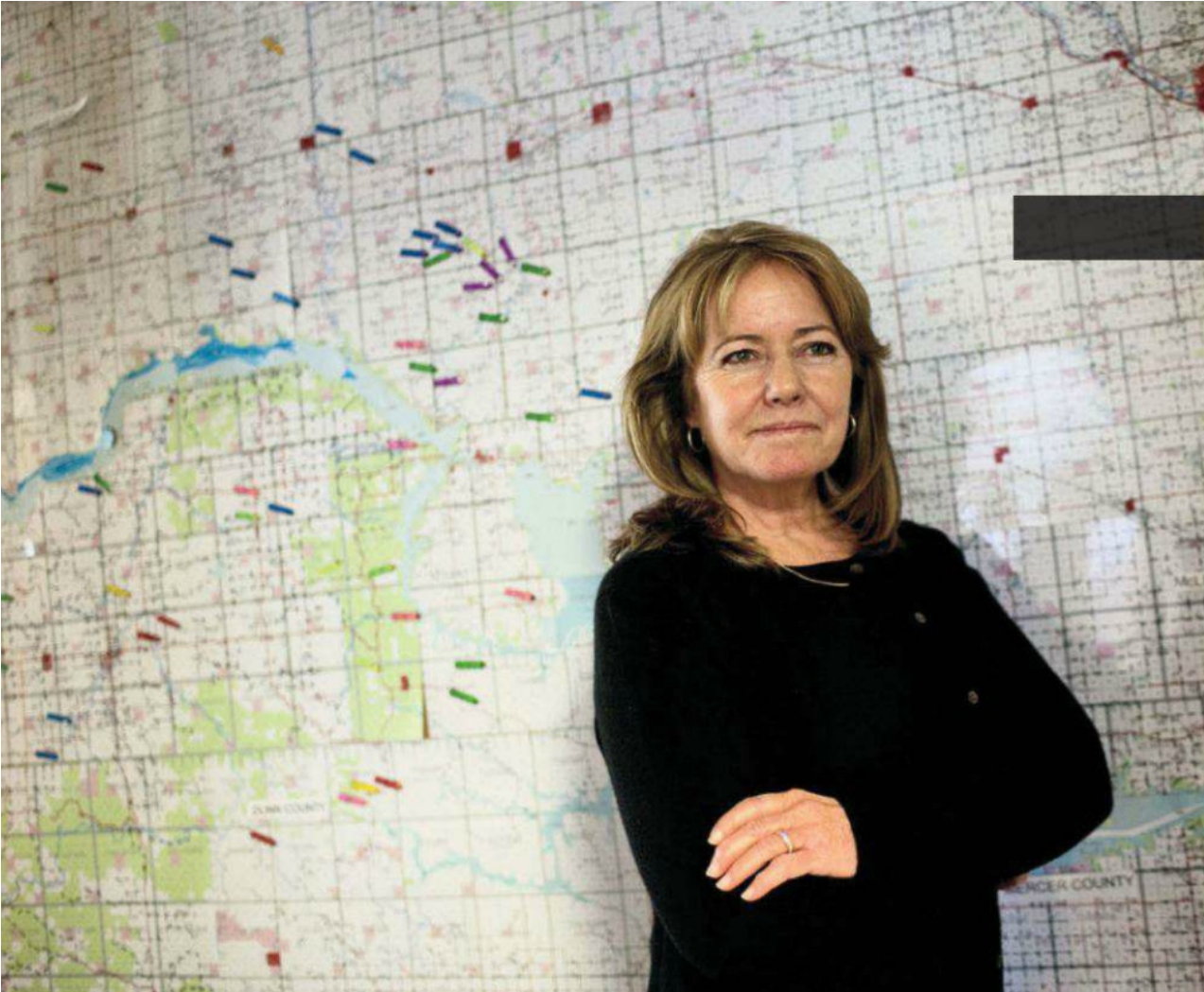
**RAIL:**  
115,000  
barrels/day  
[25.4%]



**PIPE:**  
337,500 b/d  
[74.6%]







*Local geologist Kathleen Neset and her husband, Roy, founded a consulting firm that helps petroleum companies at nearly half of North Dakota's 200-plus active rigs locate oil-rich rock.*

dwellers have faced annual rent increases of almost 300 percent and that “seniors who had been living in Williston their whole lives were having no choice but to leave town.” By necessity, more than a dozen temporary “man camps” have sprouted in the Williston Basin to house thousands of workers. I spend a night in one of them and experience an ambience that is midway between a Motel 6 and a minimum security prison.

Some locals are also concerned about fracking’s environmental impacts, especially those related to water. In the Williston Basin, where typically less than 15 inches of rain fall per year, fracking a single well requires around 3.5 million gallons of water, enough to supply a town of 1000 people for close to six weeks. Lynn Helms, the head of the state’s oil and gas division, said last year that North Dakota is “pretty much maxing out our available water resources.” Much of the water for fracking is delivered by truck. Helms and other state officials are hoping to obtain permission from the Army Corps of Engineers to draw water from Lake Sakakawea, which lies just south of Williston.

The idea that subterranean fracking could directly pollute the state’s aquifer horrifies environmentalists, though this concern stems in part from a faulty understanding of the process. The Williston Basin’s aquifer is 2000 feet deep and is shielded from contamination by 8000 feet of rock that separates it from the Bakken Formation far below. “We are nowhere near our water zones when we’re fracking our wells,” Neset says.

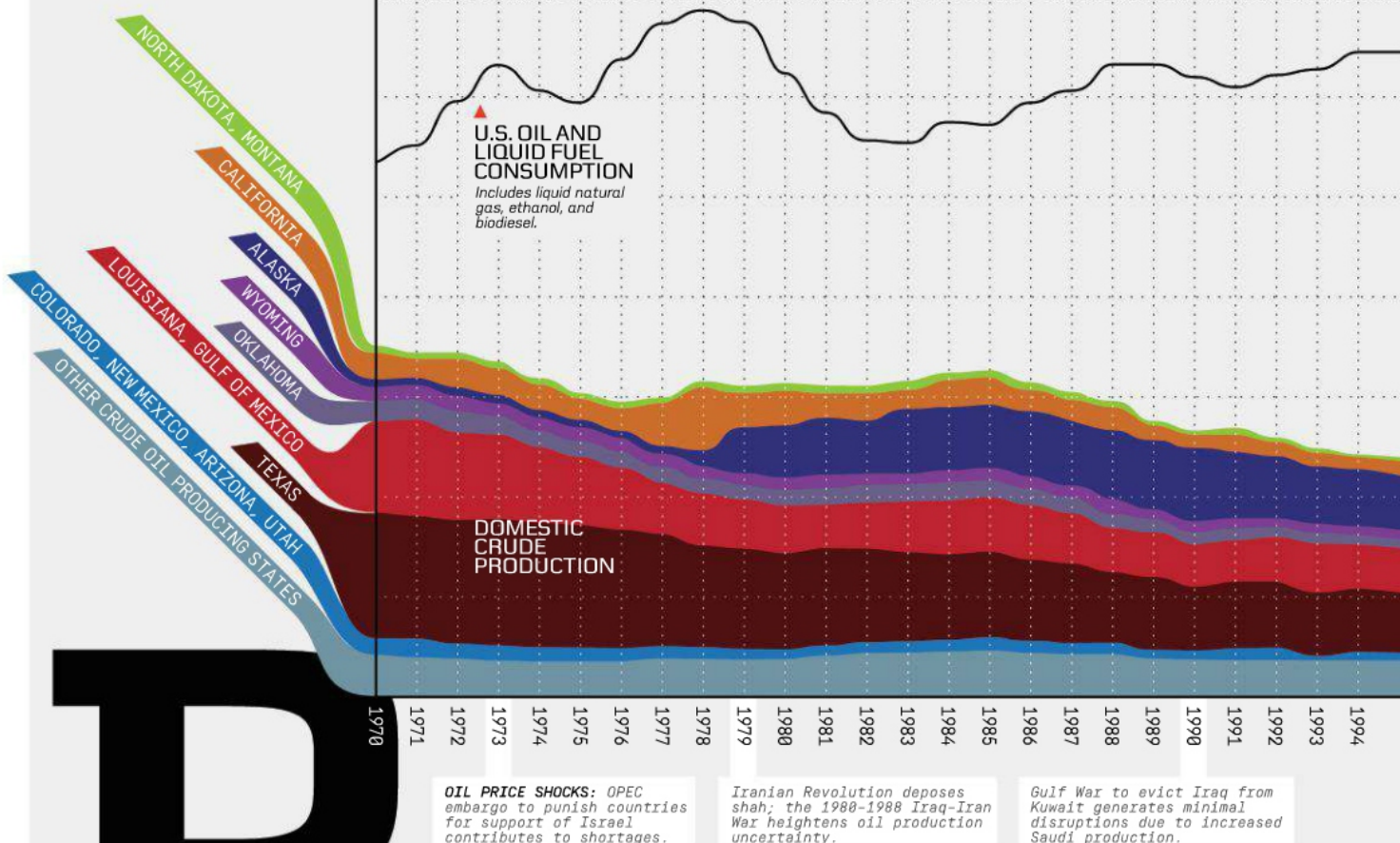
Oil, however, does have to pass through the aquifer when it’s being pumped to the surface. To prevent any oil from accidentally seeping out, the well bore has double layers of steel and

cement casings, which in theory are perfectly secure—so long as workers didn’t make any mistakes during installation. (A casing failure was one of the primary causes of the Deepwater Horizon disaster in 2010.) “Any time you have humans and machines working together, you’re going to have an error somewhere,” says Donny Nelson, a Williston Basin cattle rancher and member of the Dakota Resource Council.

Perhaps the most significant environmental concern about fracking is not what happens during the process but afterward. The millions of gallons of chemical-laced fracking solution from each well are deep-injected into the ground after use, removing them from the water cycle but also raising the spill risk if the transfer is mishandled. The drill cuttings, meanwhile, are dumped into on-site pits, which have the potential to leak. The Environmental Protection Agency is investigating possible groundwater contamination from hydraulic fracturing operations in Pavillion, Wyo.; a draft report released in December



## CAN WE DECLARE ENERGY INDEPENDENCE?



residential candidates all agree on one point: The U.S. must end its reliance on foreign oil. As a candidate in 2008, Barack Obama promised to "eliminate the need for oil from the Middle East and Venezuela" in 10 years. Mitt Romney's energy adviser agreed that a similar goal is attainable. Other politicians and pundits also claim that the U.S. is marching toward energy independence; a recent pair of Citigroup reports offered specifics on how to reach that elusive goal. But how realistic are these expectations? PM examines the truth behind the numbers.

Reporting by Steve Rousseau

## OIL-INDEPENDENCE REALITY CHECK: CLOSING THE GAP

The 2012 Citigroup reports offer a best-case scenario on how the U.S. could achieve energy independence by 2020.

**SHALE OIL: 1.1 BILLION BARRELS/YEAR (B/YR)**

To reach this figure by 2020 would mean a lot of drilling. Shale-oil plays tend to deplete far faster than conventional

fields. The Bakken's 25 percent increase in output between 2009 and 2012 required a 280 percent increase in the number of wells, from 891 to 3350. Another 25 percent increase would drive the well count to at least 9400.

**OIL SANDS: 1.3 BILLION B/YR**

The projection is based on output from Canadian oil sands, although that is a foreign source. Even so,

the Canadian Association of Petroleum Producers estimates that output will hit an annual total of only 1.1 billion barrels by 2020. But there's no guarantee that this crude will end up in the U.S. and not China. "Market pull will draw supply," CAPP spokesman Travis Davies says. Canada is accelerating plans for a pipeline to ship crude from Alberta to a Pacific terminal, while environmental concerns delay pipelines to the U.S.

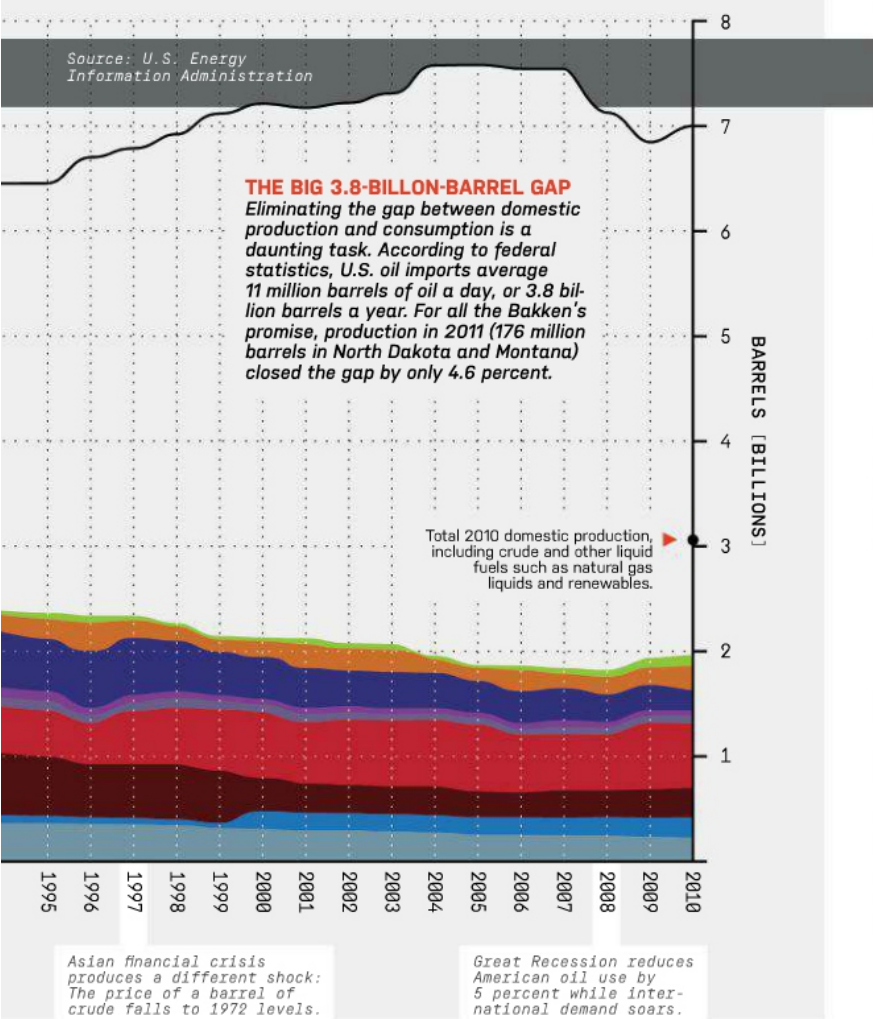
**GREEN CARS: 730 MILLION B/YR**

Natural gas vehicle boosters claim 1.5 million vehicles could be sold by 2020—but that saves only 150 million b/yr. The most optimistic projection of electric vehicles, from University of California, Berkeley, sets a 2020 figure at 45 percent of new car sales—up from today's 0.0015 percent. That change would reduce oil use by about 365 million b/yr.

**GULF OF MEXICO: 1.4 BILLION B/YR**

The Citigroup report cites this amount as an achievable goal by 2020. But after the Deepwater Horizon disaster, few experts think there will be enough wells approved to hit this level of production. According to federal figures, which factor in the impact of current regulations, production in the Gulf will increase to only 0.7 billion b/yr by 2020.





2011 stated that "detection of high concentrations of benzene, xylenes, gasoline range organics, diesel range organics, and total purgeable hydrocarbons . . . indicates that pits are a source of shallow groundwater contamination."

**T**HE AMERICAN PETROLEUM INSTITUTE'S Chili Cook-Off is a big event on the Williston social calendar. Hundreds of attendees pack a hotel atrium and crowd up to the well-stocked bars. A country band atop a high stage cranks out Gretchen Wilson's "Redneck Woman," while servers at booths from Halliburton, National Oilwell Varco, and Calfrac dish up bowls of fiery chili. Even here, where the industry has come to toast itself, nobody pretends that the boom is impact-free. But people are making money, that finest of mood-altering drugs, and many folks believe they're making history as well.

Sitting at one of the long tables in the center of the room, Larene Grondahl says that she is profiting from the rush. "I'm an oil baroness," she jokes, explaining that she inherited a one-fifty-second share of the mineral rights for a well and receives a few thousand bucks a year in oil company royalties. Some people who wholly own well rights receive far more. "There's farmers

up here getting hundreds of thousands of dollars every time they get a check," Dennis, Larene's husband, says.

The Bakken isn't the only unconventional play that's boosting incomes and, potentially, oil supplies. Amy Myers Jaffe, director of Rice University's Baker Institute Energy Forum, estimates that the Americas have 6.4 trillion-plus barrels of unconventional resources, from the oil shales of Colorado and Utah to the oil sands of Canada and Venezuela. By comparison, conventional Middle Eastern and North African fields hold about 1.2 trillion barrels. She predicts that "by the 2020s, the capital of energy will likely have shifted back to the Western Hemisphere."

Skeptics, meanwhile, point to those high extraction costs and low recovery rates in places like the Bakken. North Dakota wells are indeed gushing but haven't made up for the long-term production declines from oil states like Texas and Alaska. U.S. domestic oil production peaked in 1970 at 3.5 billion barrels a year, according to the Energy Information Administration; the output today is only 2 billion barrels. Paul Horsnell and Amrita Sen, two energy sector analysts for Barclays Capital, recently cautioned investors to be wary of euphoria and excess optimism when it comes to domestic supply. "Does shale oil help the U.S. reduce its dependence on foreign oil? Yes, it does," the analysts wrote. "But does it remake the U.S. into the next Saudi Arabia? No, at least not yet."

But people at the Chili Cook-Off know just exactly where they stand on oil in the Americas: They're betting long. Statoil's Rankin finds me in the crowd and invites me up to a small party in a hotel room that overlooks the atrium. There's chili in a Crock-Pot and Miller Lite on ice in the bathtub. Rankin introduces me to his wife. They're both from elsewhere but are having a house built on 20 acres of land east of Williston.

The rock beneath North Dakota has as many as 30 oil-bearing zones, of which the Bakken is just one, and Rankin is betting he'll be working here for a while. "Today we're targeting the Bakken; five years from now it's the Tyler, Lodgepole, Birdbear," Rankin says, naming stratigraphic formations. "We're just getting started." **PopMech**



THE INTERNET

*Will Be*





# Just Fine

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# GO PRO

AND MEGAPIXELS

THE GOPRO STORY—HOW AN ENTERPRISING SURFER WITH A TOUGH LITTLE CAMERA CREATED AN EMPIRE.

**BY ROBERT MORITZ**

•

PHOTOGRAPHS BY NATHANIEL WELCH



## IT'S A FOGGY MORNING IN HALF MOON BAY, ABOUT 2 MILES FROM THE

legendary Mavericks surf break just south of San Francisco. The parking lot is packed with 4x4 pickups and other mud-splattered vehicles outfitted with surfboard and bike racks. I'm led inside the GoPro headquarters by Rick Loughery, the company's steel-jawed director of communications, who's wearing a T-shirt emblazoned with the words "manufacturing stoke."

We thread past a cube warren populated by twentysomethings dressed in the wrinkled cotton of passengers who just landed on the red-eye from Reykjavik (which some of the staffers very likely did). Duffel bags stuffed with outdoor gear crowd vacant desks while videographers stare into 27-inch monitors, editing footage captured at the most recent Winter X Games.

We weave our way to an office, where Nick Woodman, the 36-year-old founder and CEO of the upstart camera company, is double-fisting cans of Red Bull—his rocket fuel of choice—and watching a high-definition cavalcade of GoPro-sponsored athletes leaping out of airplanes, tumbling off mountains, plummeting over waterfalls, and diving into hot tubs on every continent. The frenetic action has been stitched into a promotional video for the company's latest creation, the \$300 HD Hero2, the culmination of a decade's worth of tiny, armored cameras designed to be mounted on bike han-

A man in a black wetsuit is holding a white surfboard vertically. A GoPro HD Hero2 camera is mounted on the nose of the surfboard. The man is looking towards the camera. The background shows a beach and the ocean under a cloudy sky.

GoPro founder  
Nick Woodman  
with his HD  
Hero2 camera  
near the  
Mavericks  
surf break in  
Half Moon Bay,  
Calif.



dlebars, snowboard helmets, and car hoods.

Woodman's distillation of the essence of the GoPro mission is equal parts corporate messaging and surferspeak: "Our goal was to create a celebration of inspired humans doing rad stuff around the world." In fact, Woodman is, to an extent, underselling the GoPro effect. The 8-year-old company not only has celebrated the antics of those inspired humans, it has also created a virtuous circle of video reinforcement that defines and motivates the culture of extreme sports. Woodman—a wave rider, race-car driver, mountain biker, and snowboarder—lives the lifestyle his indestructible cameras capture. He is proud that those cameras and accessories such as the new Wi-Fi BacPac, which adds remote capture and sharing features, form their own feedback loop that continuously adds functionality without stranding older equipment. The backward compatibility with cameras dating to the original HD Hero from 2009 keeps customers happy—and the Lego-like upgrades encourage people to buy deeper into the GoPro system. That resulting combination of customer enthusiasm and loyalty sold more than 800,000 cameras last year to users who then upload videos to YouTube once every 2½ minutes.

Woodman didn't set out to redefine the market for digital imaging. He just wanted to shoot decent surfing photos. In early 2002, after his games promotion company, Fun Bug, flamed out in the wake of the dot-com bust, he took off with his girlfriend (now wife), Jill, to surf-bum in Southeast Asia. The waves were world-class, and the art major from the University of California, San Diego, wanted to take high-quality action shots of his buddies on their boards. "Surfing is such an incredible experience with a huge ego element," he says. "Did you see that wave? I got so barreled! No? You didn't!"

But unless you dragged a cameraman with a wide-angle

lens into the tube with you, the best you could do was lash a disposable camera in waterproof housing to your arm with a rubber band. Woodman started thinking, what if I make a wrist strap with a mechanism that pivots the camera out of the way while I'm surfing, pop it up for the money shot, and then fold it down again? Between paddling out for sets in Sumatra and Java, he spent his time creating prototypes from old surf leashes.

When he and Jill returned to California in August 2002, they spent three months traveling the coast, living out of Woodman's 1974 VW bus and selling bead-and-shell belts they had picked up for \$1.90 apiece in Indonesia as \$60 fashion accessories at concerts and flea markets. With the profits and a \$35,000 family loan, Woodman continued refining his prototypes on his mother's sewing machine, moving back home to save money.

There was just one problem: The straps worked fine but the technology didn't. "Every camera I used would flood or break after a big wipeout," he says. "I realized I shouldn't be a strap company, but a camera company."

Woodman didn't seem to understand that switching from the sports-accessory industry to the consumer-electronics business (which is dominated by huge companies such as Sony, Canon, Nikon, and Panasonic) is akin to going from intramural hoops to an NBA tryout. "Most businesses that enter categories like this don't bootstrap with one dude going to Starbucks every morning to, like, get himself pumped up for the day, saying, 'I am doing this!'" Woodman says, laughing at his lack of a strategic plan, team, or money. "Looking back on it, it's crazy that we've gotten to where we are now."

Maybe not. It's unlikely that the HD Hero would have emerged from a digital-imaging company. The industry's leaders were busy trying to stuff more bells, whistles, and

megapixels into shiny cameras for the masses. No matter how obsessively he looked, Woodman could not find a camera he could transform into a tough-as-nails rig that would work in any kind of action. "I went to all the major camera shows, walking every aisle, and I'm maniacal," he says, "When I say I looked at every booth, I looked at every booth twice."

It took him two years to track down a Chinese company online that made an inexpensive, reusable camera for snorkelers and was willing to modify the design to accept strap mounts. Woodman's original camera used 35-mm film even as the rest of the market was swiftly moving to digital. He couldn't afford it at the time. And since he didn't know how to render a 3D CAD model, he made an old-school prototype, using a Dremel tool, plastic blocks, and glue. He mailed it to China, wired \$5000, and crossed his fingers. "I had no idea if I was dealing with a real

## "MOST BUSINESSES DON'T BOOTSTRAP WITH ONE DUDE GOING TO STARBUCKS TO GET HIMSELF PUMPED UP, SAYING, 'I AM DOING THIS!'"



Woodman in 2002 with his father and his beloved [yet now stolen] Volkswagen bus.



factory or a sham," he says.

It turned out the manufacturer was legit, and GoPro was in business. At an action-sports trade show in San Diego in 2004, the company landed its first customer: a Japanese distributor that ordered 100 cameras. (The celebration was tempered on the show's final night when Woodman's VW bus was stolen.) By 2005, GoPro still had only two employees—Nick and his buddy Neil Dana. In 2006, the firm came out with its first Digital Hero camera, and Woodman fulfilled a lifelong dream by enrolling in auto-racing school. He strapped a Digital Hero to the roll bar, but the punishing vibrations destroyed the camera's internal components and rattled the batteries off their connectors. The experience prompted a redesign that resulted in a product line that is essentially mil-spec.

The phenomenon that truly launched GoPro was a collision of good timing and lucky engineering. In the fall of 2006, Google bought a little company called YouTube, and by sheer dumb luck the 3-megapixel Digital Hero 3 with VGA video launched in spring 2007. "The name-brand cameras at the time didn't shoot very good video," Woodman says. "It was an afterthought, but within four months, the market had shifted. Our consumers and retailers went from asking, 'How's the photo quality?' for which we had an okay answer, to 'How's the video quality?' for which we had a great answer." Thanks to YouTube, sales tripled that year and have continued at a similar pace ever since.

But taking high-quality video is only half the equation for GoPro's success. To make videos worth watching, a camera has to get where the action is. The Hero was designed to be a great camera for surfers, but it turns out the qualities of a good surf camera translate perfectly to other action sports. GoPros are small, light, and waterproof—and their signature wide, nearly fish-eye lenses seem to magically make subjects look, well, more heroic than they might otherwise be. That wide lens shoots your knees and skis, or your hands on the handlebars of a bike. The result is a big, immersive, ego-enhancing image. GoPro cameras are structurally designed to flip the traditional relationship of cameraman to subject, aligning it more closely with the way people shoot video in the YouTube era. The cameraman is the protagonist of his own video, and the lens stretches wide enough to fit in both him and the world he is conquering.

And now the professional crowd has grown to love

## GOPRO'S GREATEST HITS

By Michael Frank

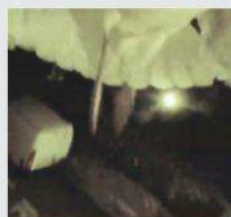
### Mountain Biker Taken Out by Buck

Plot: A pro mountain biker in South Africa is bowled over by a red hartebeest, leaving him writhing in pain.  
FFD to ... Don't. Stay for all 75 seconds.  
Views: 13.5 million. Link: [youtube.com/watch?v=S2oyMHYV1M](http://youtube.com/watch?v=S2oyMHYV1M)



### Kayaking With Redondo Beach Blue Whales

Plot: Closeups of the world's largest mammals.  
FFD to ... 2:15, when a kayaker dives into the ocean to get even closer.  
Views: 1.3 million  
Link: [youtube.com/watch?v=HVtw94PJ8XA](http://youtube.com/watch?v=HVtw94PJ8XA)



### Seagull Steals GoPro

Plot: Angry bird [singular] thinks a GoPro is a baguette in Cannes, France.  
FFD to ... 38 seconds, when the bird lands.  
Is this a hoax, though? How did the owner track the bird?  
Views: 3 million  
Link: [youtube.com/watch?v=rIu5B3Fsstg](http://youtube.com/watch?v=rIu5B3Fsstg)



### Jeb Corliss and Roberta Mancino—Wingsuit Fliers

Plot: The death-defying love story of two people who jump off cliffs and fly.  
FFD to ... 8:15, when Corliss, flying at 120 mph, nearly knocks down a colleague on the ground.  
Views: 24,000  
Link: [vimeo.com/29629657](http://vimeo.com/29629657)

Heroes. Emmy-winning cameraman Andy Casagrande IV has used them to capture everything from the inside of a shark's kisser to the inside of a lion pride. "GoPro is revolutionizing wildlife filmmaking," he says. For Discovery Channel's Shark Week, Casagrande created the Bite Cam (two Heroes embedded in a foam decoy) to capture the perspective of a seal as it's being devoured. "Before GoPro, no other cameras offered anywhere near the quality we needed. And since they're [relatively] cheap, the film industry treats them as nearly disposable cameras."

Based on data supplied by its retail partners, GoPro estimates that it owns 90 percent of the rugged camera market, which is the place you want to be if you're trying to sell a device that records video. "In a camcorder market that declined by 30 percent in the 12 months ending February 2012, the waterproof/rugged sector in which GoPro plays rose by 75 percent in revenue," says Liz Cutting, senior imaging analyst at NPD Group, a market research company.



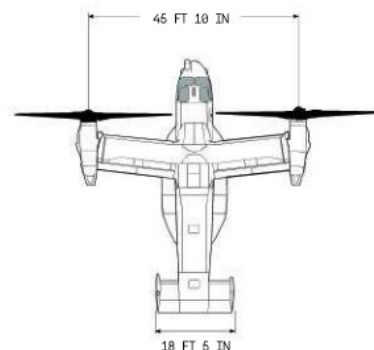
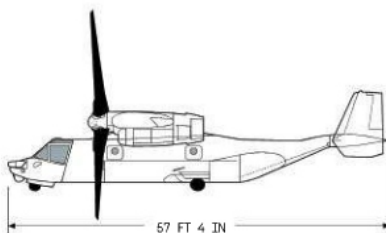
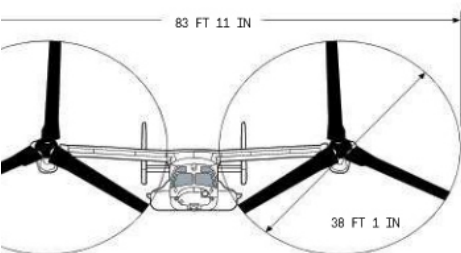


# FIXING THE WORLD'S MOST COMPLICATED PLANE

**THE V-22 OSPREY, HAUNTED  
BY FATAL TEST FLIGHTS, IS  
REDEEMING ITSELF IN COMBAT.  
BUT THE BATTLE TO PROVE IT'S  
AFFORDABLE IS FAR FROM OVER.**

BY JOE PAPPALARDO

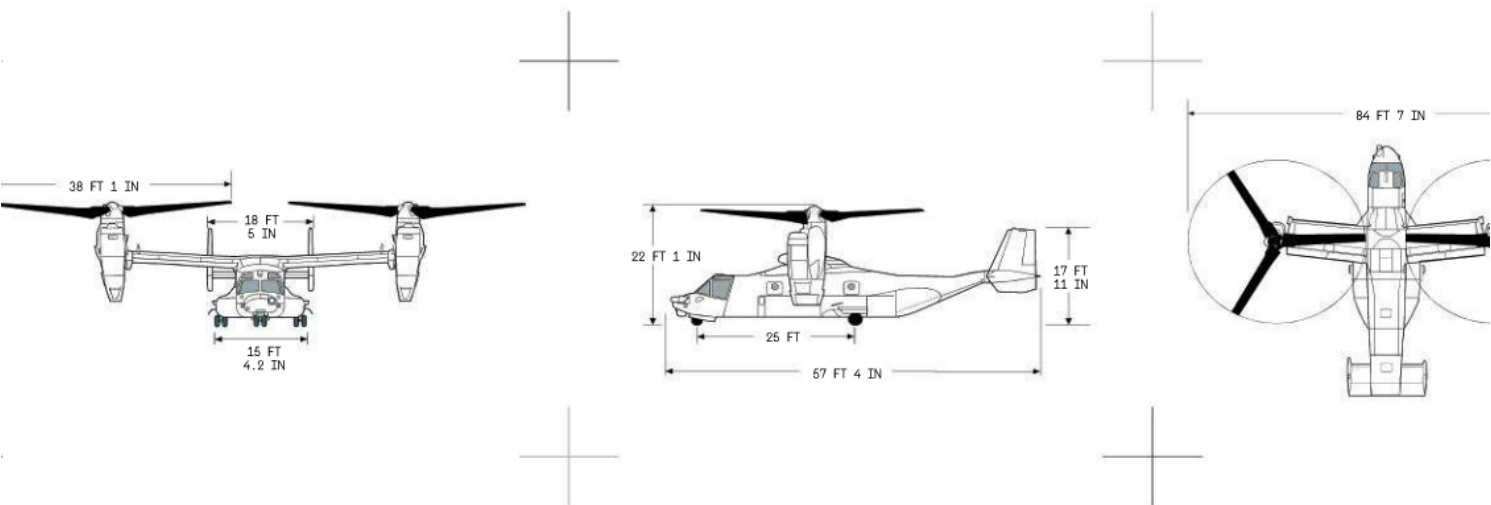
PHOTOGRAPHS BY JUSTIN FANTL



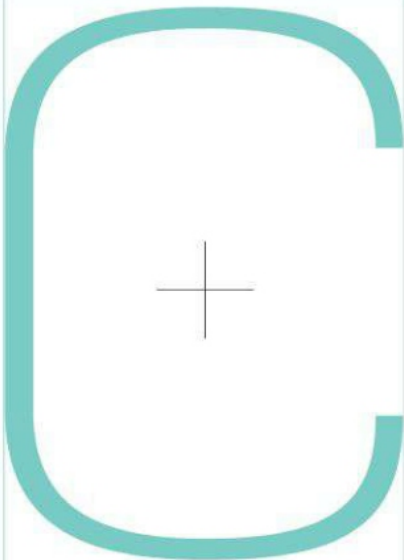




*An MV-22, proprotors folded for stowage, sits on the flight line at Marine Corps Air Station Miramar.*







**CAPT. ART “PAPI” GUZMAN, GAZE** fixed forward, strides through the hangar at Marine Corps Air Station Miramar in San Diego. The stoic pilot is focused on the day’s mission. His hard, square face probably wouldn’t flinch if a tennis ball bounced off his forehead.

Guzman must haul 8600 pounds of high-octane aviation gasoline 100 miles north, over the peaks of the Chocolate Mountains. The trip will take 20 minutes. A half-hour after landing, the two Marines riding in the back will convert an empty patch of desert into a refueling station for Cobra attack helicopters that are conducting live-fire rocket practice.

This training mission is ideal for Guzman’s ride. An MV-22 Osprey can carry 20,000 pounds of cargo (or 24 troops) internally. No other Marine helicopter can deliver this much fuel as quickly; the V-22 goes twice as fast as the tandem-rotor CH-46E Sea Knight and it can transport nearly three times the payload.

What makes the Osprey unique is its ability to tilt its rotors, producing more lift than thrust, which enables the airplane to hover and fly like a helicopter. Two Rolls-Royce AE 1107C-Liberty engines, each delivering 6150 shaft horsepower, are mounted within nacelles at the tip of each wing. Those nacelles can rotate 38-foot-diameter propellers between 0 and 96 degrees in as little as 12 seconds. “Anytime I’m in helo mode,” Guzman says, “I want to go faster.”

Two Ospreys have been charged with completing today’s task; VMM-161, the Greyhawks, are training for an upcoming

TWO SERVICES UTILIZE THE OSPREY: THE MARINE CORPS USES THE MV-22 AND AIR FORCE SPECIAL OPERATIONS COMMAND USES THE CV-22. THE AIRCRAFT ARE NEARLY IDENTICAL, BUT EACH HAS SEVERAL DISTINGUISHING FEATURES.

ANATOMY

## SPECIAL OPERATIONS CV-22 OSPREY



### NACELLES

The most audacious feature of both versions is the engines, mounted on the ends of the wings and designed to pivot, so the aircraft can fly in airplane and helicopter modes. Pilots manipulate a thumb wheel to adjust the angle of the nacelles, which move in tandem.

### FUEL TANKS

One way a special operations Osprey differs from the Marine Corps variant is the extra fuel tanks. The CV-22 was built with four additional fuel tanks in its wings. Auxiliary tanks can be rolled onto both versions for extra range.

### MULTIMODE RADAR

The round bulge at the nose of a CV-22 is a multimode radar, which serves primarily as a terrain-avoidance system. MMR also features a mode that provides real-time weather data. [The Marines have just finished testing a weather radar for the MV-22.]

### COMBAT RADIUS



• CH-46E  
75 NAUTICAL  
MILES

• MV-22  
325 NAUTICAL  
MILES

*The MV-22 carries almost three times the payload of the CH-46E Sea Knight helicopters it is replacing. The combat radius is more than four times that of the older Marine helicopter.*

ing mission to Afghanistan and the squadron needs flight time. Under a leaden sky that promises more rain, Guzman’s co-pilot and ground crews are prepping the Ospreys. Their rotors start to spin, the wash tracing intricate patterns on the rainwater pooled on the tarmac.

## COSTS AND BENEFITS

No other modern military aircraft evokes the reaction generated by the Osprey. It’s an engineering marvel and a target of abuse. Crusading bloggers and politicians denigrate it; pilots and military brass say it is





#### REFUELING PROBE

The CV-22 can fly 500 nautical miles on a full tank. But it often needs to refuel on return flights from long missions. In the cockpit, a Traffic Collision Avoidance System supplies the refueling tanker's altitude and climb/descent information.

revolutionizing the concept of air mobility. Regardless, the aircraft is here to stay. The Marine Corps and the Air Force Special Operations Command both use Ospreys, and both will receive more for years to come.

With its ability to shape-shift, the V-22 is a complicated aircraft. Miles of hydraulic and fuel lines run through the wings, and the fuselage must be tough enough to resist deformation despite the movement of the two 971-pound engines. Adding to the challenge, the propellers must fold so the V-22 can operate from ships.

A litany of problems—leaking hydraulics, onboard fires, and in certain conditions, aeronautic instability—plagued the aircraft during its 30-year development. This troubled program took a human toll—30 Marines were killed in three crashes during testing. Engineers have systematically addressed the plane's design flaws (see “A Legacy of Fixes,” page 82), but the media piled on to what they saw as an obvious villain; the abuse reached a peak in 2007, when a *Time* magazine cover story labeled the Osprey “A Flying Shame.”

The stigma still lingers. In the past year the *New York Times* editorial board has denounced the V-22 as “accident-prone” and “unsafe.” An April MV-22 crash during a training exercise in Morocco that killed two Marines will likely feed into this reputation.

But since its 2007 deployment the Osprey has proved to

be safe while flying in some of the most inhospitable conditions imaginable. There has been only one fatal crash in combat: In 2010 in Afghanistan an Air Force CV-22 touched down short of its landing zone, hit a ditch, and flipped, killing four of the 20 aboard. “Over 10 years, Ospreys have been the Corps’ safest combat rotorcraft,” says Richard Whittle, author of *The Dream Machine: The Untold History of the Notorious V-22 Osprey*.

The advantages that the Osprey brings to the battlefield have been displayed during deployment. Not only can V-22s carry larger payloads, but they can also cover more than four times the distance of the Sea Knight. For the Marines and special operators who rely on the Osprey’s speed, those are crucial capabilities.

In 2010, a helicopter was wrecked during a raid in Afghanistan,

stranding dozens of special operations soldiers who came under attack from small arms and mortar fire. When other helicopters were turned back by dust storms and the high peaks of the Hindu Kush, two CV-22s made the 800-mile rescue, soaring 15,000 feet and over the mountains. The mission returned 32 U.S. personnel in less than 4 hours. A year later, an F-15 pilot who had crashed in Libya was rescued by MV-22s flying from an amphibious assault ship. The Marines returned the pilot to the vessel, 150 miles away, in just 30 minutes.

U.S. Air Force Maj. Brian Luce, a pilot with the 8th Special Operations Squadron, flew the Osprey in Afghanistan and saw firsthand how it turned doubters into converts. “Some of the guys have a little hesitancy,” he says. “But then they ride with us and get from point A to point B in record time.” Luce says mission planners and combat commanders have also learned to appreciate the Osprey’s capabilities. “The range and speed of a CV-22 are phenomenal,” he says. “They are realizing this and are adjusting their tactics and procedures.”

Those benefits come at a steep price. The V-22’s research and development program was supposed to cost just over \$39 billion, but independent estimates predict that it will come to \$56 billion—43 percent higher. This price tag—about \$100 million per plane, including development costs—becomes a bull’s-eye each time politicians look for budget cuts. The 2010 bipartisan deficit commission proposed termination of the Osprey in its list of suggested savings.

The White House’s proposed 2013 budget trims 24 aircraft (from 122 to 98) over five years, saving \$1.75 billion. But those orders could be reinstated during negotiations of the Pentagon’s contract with Osprey maker Bell-Boeing. The fact that the Osprey has escaped the budget ax’s deepest cuts confirms its improved reputation within the military.

Despite its successes, the V-22 still has something to prove. Critics have found another source of ammunition to aim at the hybrid aircraft that everyone loves to hate.

## A MISSION DENIED

Guzman frowns at the darkening sky as he leaves the hangar. A cold rainstorm is lashing the area. The F/A-18s



flying from the base have reported icing within a cloud layer between 5000 and 16,000 feet. Those clouds are blocking the mission's flight path over the Chocolate Mountains, which the pilots refer to as the Hill.

Most of the de-icing systems in the squadron's Ospreys are not working, placing the craft under Naval Air Systems Command-mandated restrictions that govern where Guzman can fly. This puts the mission in jeopardy.

"The amount of ice up there won't even degrade performance," Guzman says. "I could punch through to 16,000 feet and it'd be a clear ride to the other side of the Hill." These rules are relaxed in combat zones, but extra precaution is taken during training flights.

Late last year a report by the Pentagon's Office of Operational Test and Evaluation noted that from June 2007 to May 2010 the Marine Corps' Osprey mission-capable readiness was only 53 percent.

"It's tough [for maintainers] to keep them flying," says VMM-161's commander, Lt. Col. Eric Gillard. "But people don't grasp that the V-22 is a leap ahead."

Guzman stalks onto the flight line and heads for his Osprey. He climbs through the door behind the cockpit and enters the cargo bay. It is stuffed with a chest-high fuel container, pump, and hoses that will become the temporary refueling station for the Cobras. The walls are lined with tightly secured bundles of exposed wires and hydraulic lines.

Guzman enters the cockpit, nods at his co-pilot, sits in the right-side seat, and plugs in his headset. He is greeted with disappointing news: The mission has lost one bird to the malfunction of an auxiliary power unit. Another MV-22 will have to tag along later, following the mission's straggler plan. "This happens," Guzman says. "A lot."

The twin engines shake the aircraft as it prepares to rise. The graphite and fiberglass blades whirl just outside the cockpit windows, chopping air in a dark blur. Guzman's left hand moves the throttle control lever (which governs the pitch of the rotors) forward, and with hardly a lurch, the MV-22 rises into the gray sky.

The stubby windshield wipers beat back sheets of rain as the aircraft climbs to 1500 feet. After a few seconds Guzman plays his thumb across a wheel on the lever to change the angle of the nacelles.

## A LEGACY OF FIXES

The Osprey is not the same aircraft that was tested decades ago. Engineers have solved many of the problems that gave the aircraft its bad reputation.

|                        | PROBLEM                                                                                                                                                                                                                                                                         | UPDATE                                                                                                                                                                                     |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HINKY HYDRAULICS       | Titanium hydraulic lines leading to the nacelles used to rub against wire harnesses. This created holes in the lines that caused fires; in 2000 one such fire contributed to a crash that killed four Marines.                                                                  | By 2005, the problematic hydraulic lines had been rerouted. They are now easier to access for evaluation and repair.                                                                       |
| DANGEROUS DESCENTS     | Rotorcraft that descend too quickly at slow speeds can lose lift if the rotor dips too far into its own downwash. This is called vortex ring state—an Osprey in VRS can lose lift on one side and flip; 19 Marines died in one such accident during the aircraft's development. | Ospreys have audio and visual warnings that alert pilots when VRS conditions start to form. Pilots can tilt the rotors forward to escape, if the aircraft has enough altitude to maneuver. |
| UNDERARMED FOR HOT LZS | Ospreys fly into landing zones that are defended by enemy fire (hot LZs). Critics once complained about the craft's lack of armaments.                                                                                                                                          | Some Ospreys now have 7.62-mm GAU miniguns mounted in their bellies; they are remotely operated by the crew inside the aircraft.                                                           |

## ASK THE PILOT



### CAN OSPREYS AUTOROTATE?

When a helicopter's engine fails, the rotors continue to turn as the craft plummets, which creates enough lift for the pilot to make a controlled landing. Ospreys cannot perform this maneuver, called autorotation. They have other ways to land in an emergency, says

**Special Operations pilot Brian Luce.** V-22s can take advantage of the lift of the props and wings to

set down safely. "I'd look for a flat space and do a running landing," he says.

### WHAT IF AN OSPREY LOSES AN ENGINE?

Each engine couples to another gearbox in the fuselage, so one engine can drive both rotors. "Unless I am very heavy or at a very high altitude," Luce says, "I can fly this thing single-engine all day, because of that interconnected driveshaft."

Now in airplane mode—with the nacelles at 0 degrees, generating more thrust than lift—the Osprey climbs to 4500 feet, skirting the lower edge of the weather system and plowing east. The Marine pilot looks for a break in the clouds so he can zip through and drop to an ice-free altitude on the other side. But the clouds thicken and the rain smacks harder against the windshield as the aircraft rises to meet the mountains. Visibility drops to scant feet. "There shouldn't be too much traffic up here," Guzman says to his co-pilot. "But keep your eyes peeled."

He descends to 3000 feet, eyes constantly scanning the colorless mass. There's no way through. "Well, we tried," Guzman sighs into his headset.

Somewhere out in the desert, the Cobras are being refueled—by trucks. "The plane flies great," Guzman says, "when everything works."

## READY OR NOT

The same feats of engineering that make the Osprey such a game changer sap the aircraft's readiness for missions. Sen. John McCain of Arizona, a persistent Osprey critic, offered the following backhanded



compliment last year as he lamented waste at the Pentagon from the floor of the Senate: "When it is not being repaired, the V-22 performs its missions impressively."

Maintainers point out that, compared with legacy systems, the Osprey is still new. There are decades of knowledge on how to best service an aircraft like the Sea Knight, which has flown since the 1960s. Not so the V-22. "It's a new airframe and not too many people have worked on it," says Master Sgt. Simon Smith, a CV-22 maintainer based at Hurlburt Field near Pensacola, Fla. "We're still in the middle of our learning curve."

He hustles, clipboard in hand, across the flight line at Hurlburt, home of Air Force Special Operations Command (AFSOC). He's a busy guy—he will leave home for predeployment training for Afghanistan the next day to supervise the maintenance of Ospreys used on recent missions. "No telling how long I'll be gone," he says. "My bag's always packed."

The temporary duty assignment will be his 30th in 19 years. "Every time we change places, the environment adds different stresses on the airframe," he says. "The dust in Afghanistan clumps in different places than the dust in Iraq." These conditions play hell with the Osprey's performance. McCain cites Pentagon records that tally the V-22 engines' service life at just over 200 hours in Afghanistan. The military estimated that figure to be 500 to 600 hours. The shortfall has more than doubled the cost per flying hour to over \$10,000, compared with about \$4600

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per hour for the tandem-rotor CH-46 Sea Knight the Osprey was designed to replace, he said.

But those figures fail to account for the Osprey's speed and size. Whittle points to an internal Marine Corps analysis that crunches the numbers by passenger seats—12 for the Sea Knight at a cost of \$3.17 per seat per mile versus \$1.76 for the 24-seat Osprey.

Special operations pilots like Luce say the maintainers are getting better with experience and that combat deployments have sped up the learning process. AFSOC does not release readiness rates, but at Hurlburt Field the CV-22 has earned a reputation as an attention hog yet gets decent reviews for readiness. "During my last three-month deployment [to Afghanistan], we never had to cancel a mission for maintenance," Luce says. "The maintenance force is definitely maturing."

He says the Osprey's notoriety is caused in part by its stature. "The CV-22 is high-visibility, sort of the flagship for AFSOC," he says. "It costs a lot of money, so people want to see results."

The struggle between capability and cost doesn't look the same on a spreadsheet as it does from the cockpit or an isolated landing zone. The truth is somewhere in between: The Osprey may be too costly to keep, but it's becoming too useful to abandon. **PopMech**

*A Marine Corps maintenance crew works on the aircraft's propellers. The blades are jointed so they can fold when the aircraft is stowed inside ships.*





BRUSH CUTTER  
09/29/2011

CEILING FAN  
03/21/2012

FOOD DEHYDRATOR  
01/20/2011

SHOES  
11/16/2011

PRINTER  
02/02/2012

LAPTOP  
05/27/2011

TOASTER  
12/15/2011

STROLLER  
11/09/2009  
02/22/2012

COFFEEMAKER  
02/09/2012

BELAY DEVICE  
08/30/2011

ICE CREAM SCOOP  
12/20/2011

CUTLERY SET  
06/14/2011

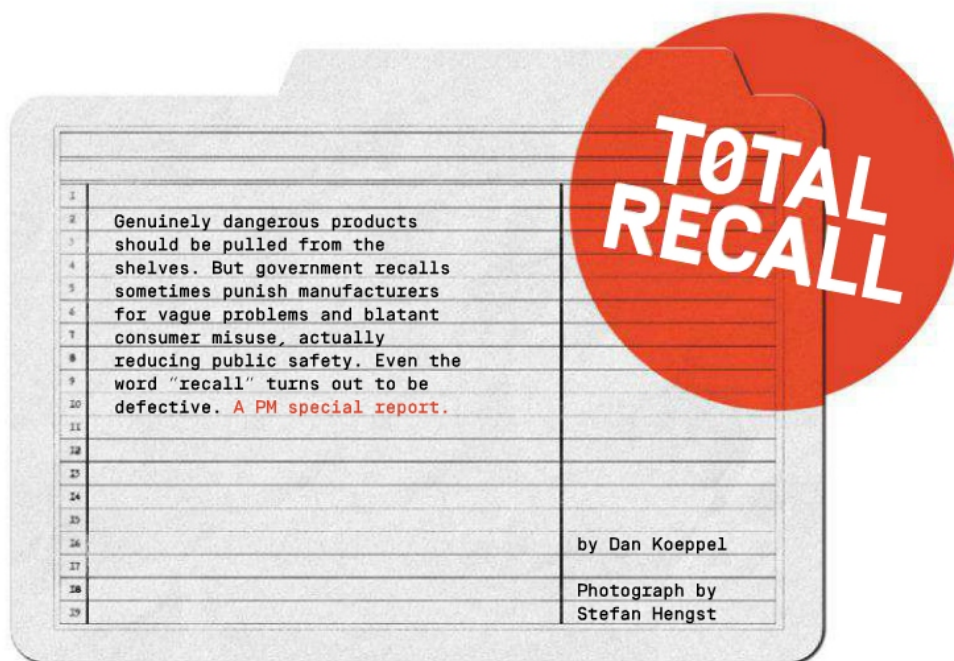
TEETHING RING  
01/12/2011

GLASS LID  
02/23/2011





PM bought these items from sites such as eBay after they had been recalled. Recall notices are so ineffective that most people have no idea they own recalled products—or that it's illegal to sell them online.



**ELMO WAS IN DANGER.** IN THE VIDEO BRYAN DUSSAULT POSTED ON YOUTUBE IN FEBRUARY 2010, the *Sesame Street* favorite is strapped into a child-safety seat. Dussault tightens the five-point harness and then abruptly yanks the unit's shoulder straps, which are supposed to be snug against the infant passenger. The harness straps loosen. Dussault pulls the shaggy toy away as if it were being tossed, unprotected, in a

high-speed collision. To anyone viewing the clip, but perhaps especially to anyone who travels in a car with a child, the scenario is startling and scary.

The series of events that led Dussault to film the sequence began on a freezing Chicago day earlier that winter. At the time his son was 3 years old. It was Grandma's turn to pick up the boy at preschool. But there was a problem. "My mother-in-law called me," Dussault says, "and said she couldn't get the car-seat straps to tighten up."

Dussault drove to the school and took his child home himself, along with the car seat that had apparently failed. He owned the same item—the \$79 Vantage, purchased at Walmart and sold under the Safety 1st brand name. In his garage Dussault tested his own seat; again, the straps loosened. "I knew that if I got two doing that," he says, "there were probably thousands out there doing the same thing."

Dussault contacted the seats' manufacturer, Dorel Juvenile Group. Based in Columbus, Ind., Dorel is the world's largest maker of children's car seats. It sells about 8 million child-restraint systems—the official term for car seats—each year. But



shoppers won't find the Dorel name in stores. Instead, the company's goods appear under a range of recognizable brands including Disney, Cosco, Eddie Bauer, and Maxi-Cosi.

Dorel offered to exchange Dussault's seats. But when the replacements arrived, Dussault says they failed his test as well. He filed a complaint with the National Highway Traffic Safety Administration (NHTSA). Meanwhile, Dorel asked him to return the original seats so the company could test them, standard procedure when an exchange is offered. Dussault was hesitant. "They were hot on my tail to get these seats out of my hands," he says. The company, he believed, intended to "sweep things under the rug."

To prevent that from happening, Dussault made the video. He contacted the news media. A local NBC affiliate dispatched a crew. The demise of Elmo went viral, and in 2011 Dorel recalled 800,000 car seats. A win for Elmo and kids everywhere?

That's debatable.

*Bryan Dussault strapped Elmo into a Vantage car seat (far right) to demonstrate a potential product defect; his YouTube video went viral. The manufacturer agreed to recall 800,000 seats.*



## DUSSAULT DESCRIBES HIS STRUGGLE IN

David and Goliath terms, a concerned parent confronting a faceless corporation whose interests are driven more by sales than by safety. When it comes to products designed to protect children, that position isn't difficult to understand. I'm the father of a 16-month-old, and even before our son arrived, my wife and I did what most expectant families do: We went shopping.

I was amazed by the number of products available and dismayed by how many appeared to be defective—car seats, strollers, toys, cribs, nursery monitors. It seemed impossible to pick a category that wasn't prone to recalls. When my wife and I debated whether to allow our infant to sleep in the same bed with us, we were told that the only safe way to do so was to buy a "positioning device," a product that would prevent a sleepy parent from rolling over and smushing the poor tyke (never mind that parents have been cuddling their children to sleep for millennia). We rejected the advice, and good thing: On our next

visit to Babies "R" Us, the positioner aisle was empty. It turned out the device itself could lead to suffocation if a child were pressed against it the wrong way.

At first my impression was similar to Dussault's: a rogue industry. A little research seemed to back that up. NHTSA recalled more than 100 different models of car seats from nearly a dozen manufacturers during the past decade. And media accounts almost always emphasize the profit-trumps-all angle when it comes to product defects. Particularly notable is a 2007 *Chicago Tribune* story that chronicled Dorel's attempts to prevent an earlier recall. Dorel had argued—correctly but unsuccessfully—that the straps on the car seats weren't up to standards because there were no clear standards when they were manufactured in 2000 and 2001. Other companies, it pointed out, used materials of similar strength and design and hadn't been penalized. The reporters painted the company as uncaring, even conspiratorial—quoting an internal email from a Dorel executive who wrote: "Why? It still sells." The series of investigative reports that included the story won a Pulitzer Prize. And after losing an appeal to the NHTSA in 2010, Dorel was forced to recall about 4 million car seats.

But eventually I began to question whether product defects could really be so rampant. Most of the recalls I had read about appeared to be for items





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that caused no injuries or where injuries could only be vaguely attributed to a specific problem. As I began to search my home for recalled products—not just stuff aimed at kids, but appliances, tools, electronics, and everything else modern shoppers own and covet—I quickly became overwhelmed. There were so many recalls and so many sources of information on recalled products that I could barely keep track. Did I own dangerous items? Were they really dangerous or just potentially dangerous? And what action should I take, if any?

Trying to sort through it all was impossible, so I gave up. And in that way I became an even more typical American consumer: one unable to make my home truly safer, because the system by which we judge, identify, and correct broken gear is as defective as anything found on store shelves.

**IN THE UNITED STATES, PRODUCT RECALLS ARE OVERSEEN BY SIX** federal agencies. The majority come under the jurisdiction of the Consumer Product Safety Commission (CPSC), which handles everything from toys and power tools to appliances. Recalls connected to automobiles—cars, tires, and child-restraint systems—are within the NHTSA's purview. Boats and nautical items are regulated by the Coast Guard. Products containing chemicals, such as house paint and pesticides, are Environmental Protection Agency territory; the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) handle edibles, pharmaceuticals, and cosmetics.

The division of federal oversight—car seats to the NHTSA, strollers to the CPSC; burgers to the USDA, fries to the FDA—is just the beginning of the knot consumers need to untangle if they're hoping to learn whether a product they own poses a threat. Though there's ostensibly a one-stop database of product alerts, [recalls.gov](http://recalls.gov), the website's utility is marred by confusing design and poor information retrieval. Clicking on the Search for Recalls button opens a page with six additional search boxes, each tied to a different agency or category. If you don't know what jurisdiction a product falls under, you'll have little success, which may be just as well: Sometimes products are identified only by inventory-control codes useful to retailers and manufacturers. Photographs are often unavailable. If you do manage to discover a potentially relevant recall, you're given the investigation number assigned by the overseeing agency but not always a link to the investigative details themselves.

Details that are included don't generally provide context for injuries or useful consumer information. For example, the notice for a Task Force electric log splitter, recalled in July 2011, states that two injuries had been reported after

operators placed their hands on the handle while the splitter was in operation. The notice instructs consumers to stop using the product and send for free warning labels. "That has got to be one of the weirdest recalls we've ever seen," wrote Everett Snyder on [ProToolReviews.com](http://ProToolReviews.com). "The recall itself doesn't do too much to explain the problem or deliver specific (detailed) instructions for safe use of the tool . . . No, for that you need to wait for the stickers to show up."

This muddle is made worse by the scale and number of recalls. During the past five years, more than 150 million children's items, 110 million household goods, and 9 million pieces of sporting equipment have been recalled by the CPSC alone, according to the recall-tracking group WeMakeItSafer. There are so many recalls—nearly 1500 by all six agencies in 2011—that many consumers have simply stopped paying attention to them. A 2010 *Consumer Reports* survey found that just under 25 percent of respondents ever bothered to research whether a product they owned had been subject to a recall; of those who knew they owned a recalled product, only about 30 percent actually did something about it. There's even a new term for the phenomenon of ignoring product-safety warnings: recall fatigue. "So many recalls are announced in so many ways that when you hear it on the news, it just doesn't register," says Craig Wilson, vice president of quality assurance at Costco Wholesale Corp. "The perception is that there's a lot of crying wolf going on."

**A DAY AFTER ELMO'S MISHAP HIT CHICAGO** airwaves, the NHTSA's Office of Defects Investigation opened case PE10-009—a preliminary evaluation, which doesn't indicate that a recall is necessary or even being contemplated. Though the agency receives about 35,000 consumer complaints each year, just two—both Dussault's—had been registered for the Vantage, which had been highly rated in *Consumer Reports*.



Preliminary or not, opening an investigation also opens floodgates. The manufacturer of the product in question is required to deliver thousands of pages of data: test results, transcripts of customer-service calls, descriptions of manufacturing procedures, sales figures. The NHTSA announces the inquiry to the public, an evidence-seeking strategy that can lead to hundreds of additional complaints. For the Vantage, it yielded only six new reports, none of which involved injuries. Despite this, the agency moved the inquiry to the next level: engineering analysis. On July 2, 2010, case EA10-005 was opened: Dorel was asked to provide complete details on how the seat was built and tested, and whether any changes had been made at the factory that might have coincided with the complaints of strap slippage. Over the next couple of months, Dorel submitted thousands more pages of documentation.

In an 11-page letter to the NHTSA dated Sept. 21, Terry Emerson, Dorel's director of quality assurance, stated that no slippage had occurred in the Vantage's initial rounds of testing—2900 on crash sleds and 2000 mechanical strap pulls. The public investigation attracted 40 additional complaints, representing 0.00005 percent of seats sold. No injuries or deaths were reported. Dorel, Emerson wrote, "does not believe the subject units contain a safety-related defect."

But the company did find that some center front adjusters (CFAs)—the locking and release buttons that secure the straps—could, if excessively dirty, not tighten as well as a new product's (though that could be remedied by making sure the CFA is actually pressed firmly into place). And so, on Feb. 14, 2011, Dorel initiated a voluntary recall, offering what consumer-safety specialists call a sealed fix—a repair kit rather than a full product swap. The kit consisted of a tiny tube of food-grade lubricant; the primary ingredient, canola oil.

The main difference between Dorel's remedy and a squirt of something from a typical pantry is a sticker that comes with the kit, indicating the fix has been applied. But there is no

evidence that the tube-of-lube solution addresses what caused Dussault's seats to fail. When Dorel finally got those car seats back, it couldn't reproduce the problem. Nor could outside testers, including *Consumer Reports*, which takes an aggressive stance toward product safety. Though Dorel won't disclose how much the recall cost, its annual reports indicate the juvenile division has spent more than \$50 million in the past five years on product liability expenses.

Barry Mahal, Dorel's executive vice president for child-restraint systems, says the company agreed to the recall out of "an abundance of caution." What Mahal didn't add was that Dorel also likely agreed to the recall because it knew it couldn't win; it had already been down that road with the recall that led to the Pulitzer Prize-winning investigation. Though the *Tribune* reporters quoted a Dorel attorney pointing out that a particular car crash, not a product defect, may have caused a child's injuries, the story ended with a depiction of that child rocking back and forth in her kindergarten class, unable to speak or seemingly comprehend.

**THE INTERPLAY BETWEEN TRAGEDY AND RECALL MAKES FOR GRIPPING** narrative; there's little doubt that such stories can compel normally glacial federal agencies to react quickly. The most prominent example of this is the fairly well-known—but still poorly understood—story of Toyota and the phenomenon called unintended acceleration.

Accounts of Prius, Lexus, and Camry models unexpectedly gathering speed began to dominate the headlines in 2009. That was when the audio of a horrific 911 call—made from the car of off-duty California Highway Patrol officer Mark Saylor—garnered hundreds of thousands of online plays. Saylor and three members of his family died when their Lexus spun out of control while traveling more than 100 mph. The incident was ultimately attributed to the wrong floor mat installed by a dealer, but experts, including Joan Claybrook, former head of the NHTSA, insisted the problem had to be an electronic defect. In February 2010, Department of Transportation secretary Ray LaHood recommended that Americans stop driving their Toyotas. Three weeks later, the company's CEO, Akio Toyoda, issued a public apology. Toyota ended up recalling more than 8.5 million vehicles. The damage to the company ran

## Ortovox Avalanche Transceiver



**RECALL:** 15,500 avalanche transceivers, safety equipment used by skiers to signal their location if they're buried under snow.

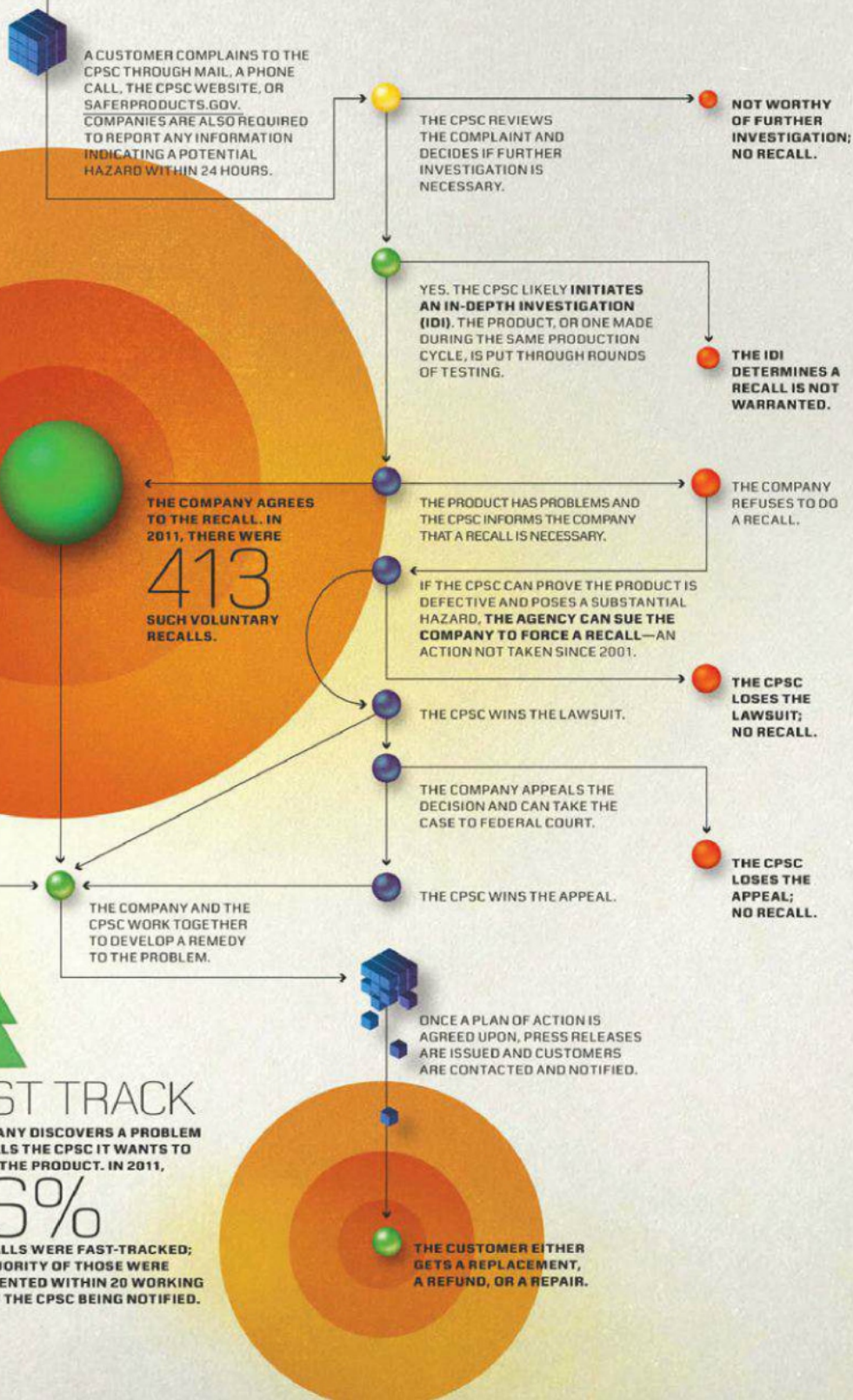
**REASON:** The Consumer Product Safety Commission received three complaints that AA batteries powering the device could loosen on impact. Only "this was a problem that couldn't be replicated or traced back to our product," says Carson Stanwood, who handled Ortovox's public relations at the time. He advised the company to cooperate. "If an official agency says something is defective and you have the temerity to deny it, you end up as the villain," he says.

**REAL PROBLEM:** Soon after the 2005 recall, the Mount Washington Avalanche Center found it could get batteries to jar loose under severe impact but identified a different culprit: the AA batteries. Due to size variance, some brands failed to fit tightly. No recall was issued for batteries, nor have standard uniform sizes ever been proposed.



# HOW A RECALL WORKS

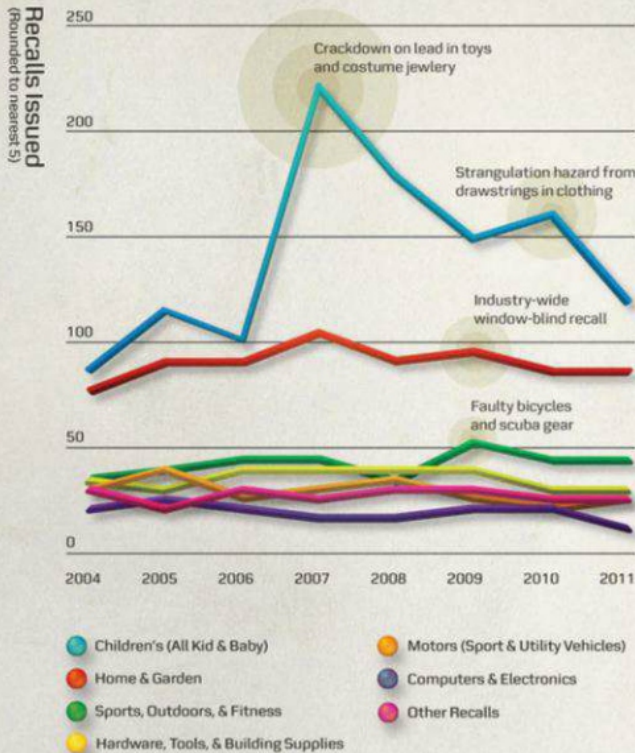
*The Consumer Product Safety Commission (CPSC) has jurisdiction over more than 15,000 types of products typically used in homes, sports, and schools. Depending on the complexity of the issue, recalls can take from weeks to a year.*





## RECALLS BY CATEGORY

Significantly more children's products, plus home goods such as appliances, are recalled each year, due in part to stricter regulation. This graph tracks the nearly 3000 products recalled by the CPSC, plus car seats recalled by the NHTSA, over the past eight years.



Source: WeMakeItSafer

into the billions of dollars: Its U.S. market share dropped from 17 percent in 2009 to 12.6 percent in 2011, putting it in third place behind General Motors and Ford.

In an effort to find the alleged bug, the NHTSA enlisted NASA to conduct the largest automotive defect investigation in history. In February 2011, the agencies concluded that no flaws in Toyota's control systems could be found. The most likely culprit, the report revealed, was "the driver's unintended application of the accelerator, rather than, or in addition to, the brake." In other words, human error.

Brian Lyons, safety and quality communications manager at Toyota USA, says that the company didn't realize how quickly media reports would snowball. "The evidence said

that there wasn't anything wrong with the electronics systems," he says. "The battle was getting the truth out there."

Though Toyota's market share is recovering, the company faces nearly 200 lawsuits. In the first of those cases, Toyota argued (in accordance with NASA findings) that driver error was the main cause of the accident—a defense that resulted in a storm of condemnation. Many of those who chastised Toyota for blaming the victim wrote for blogs operated, with varying degrees of transparency, by law firms looking to identify such victims and file claims on their behalf. These firms use technological savvy to game Web results, either by purchasing keywords and advertising or by optimizing their sites to register prominently with Google. Enter "car seat defect" into the search engine and of the first 50 results, 43 are law firms.

"What we've ended up with is a protection racket," says Michael Krauss, a professor of law at George Mason University who specializes in product liability. "These lawyers are on a never-ending search for clients. Paying them off has become part of the cost of doing business."

Krauss says that excessive litigation has skewed the entire way products are built, sold, and marketed today. Companies hesitate to deal openly with flaws because they fear litigation; consumers, noticing this, mistrust manufacturers. And the U.S. legal system has become an enabler, Krauss says, because liability cases here—unlike in most other countries—are decided by juries rather than judges, allowing room for emotion to swamp facts. Multimillion-dollar settlements are far more likely, Krauss says, "because a company is going to be very averse to being in a courtroom where aggrieved parents are holding up pictures of a

dead or disfigured child while the jury hears the evidence and deliberates."

Companies like Dorel work in such a charged atmosphere that they can't even obtain product-liability insurance; instead, they keep tens of millions of dollars reserved for private lawsuit settlements. Dave Campbell, an analyst with the Juvenile Products Manufacturers Association, says that consumers pay a premium of up to 5 percent on most kid-oriented products in order to fund settlement pools. For smaller businesses, operating closer to the margin, high liability insurance can push them out of the market—or dissuade an entrepreneur with a smart innovation from launching a company in the first place.

### GOVERNMENT HAS A ROLE IN ENSURING PRODUCT SAFETY. BUT THE BOTTOM

line is that a recall—whether or not the product is dangerous—is useless if nobody hears about it. Most current efforts to spread the word seem to do little but add to the clamor. Federal agencies now offer more mobile apps, more text alerts, and more website widgets, all drawing on the same vast stores of raw data. The most recent addition to this well-intentioned deluge is [saferproducts.gov](http://saferproducts.gov), mandated by the Consumer Product Safety Improvement Act (CPSIA) of 2008. The site duplicates much of the information on [recalls.gov](http://recalls.gov), though with a better-looking interface and a new feature: a public forum for reporting defects.

As valuable as such a tool might seem, one result has been to turn the site into



## Power X Bike

**RECALL:** 91,000 Power X bikes, sold between February 2011 and July 2011 at Walmart.

**REASON:** The bicycle chain could break, causing the rider to lose control. Eleven incidents, including nine injuries, were reported to the CPSC.

**REAL PROBLEM:** Bike chains are a generic part; the same one can typically be found on dozens of models. "It would be nearly impossible to trace back to the original manufacturer to identify every brand that the part in question was produced for," says bike-industry consultant Jasen Thorpe. "So while it may protect one group of consumers, the results of a recall are going to be imperfect." Case in point: Power X is Walmart's brand, but the bikes are made in the same factory, with the same parts, as ones sold at Costco, Target, and other outlets. Whether those bikes had a defective chain can't be determined; no additional recalls have been issued.



an electronic complaint department. (Recent incidents included a man who was burned by fireworks and another who felt nauseated after shaving.) CPSC commissioner Anne Northup objected to the use of agency resources to investigate such claims in Congressional testimony in March 2011. "Many believe the public database, if left unchanged, will be useful only to trial lawyers or advocacy groups that will be able to populate it with unverifiable, secondhand information for their own purposes," she stated. (CPSC chairwoman Inez Tenenbaum disputes the reports are unverifiable.) More promising is that the CPSC recently opened its database and underlying code. This should enable private software developers to build custom, highly targeted applications, says agency spokesman Alex Filip.

Both the NHTSA and the CPSC have also been plagued by an investigative process that hasn't kept up with technology. In congressional hearings following the Toyota recalls, NHTSA administrator David Strickland said the agency employed just five electrical engineers and one software engineer out of its 125 engineers working on automotive investigations. The CPSIA mandated that the agency improve its technical facilities so it could conduct more authoritative product tests. In a 2011 report to Congress, the CPSC said that it was unable to adequately accomplish that goal because it "lacked the necessary infrastructure to directly accredit the testing laboratories." In both internal documents and public statements, the federal agencies admit to being as overwhelmed as consumers. "We've got very, very full plates, and we don't move at the speed we'd like to," an NHTSA official told me. "But we do what we can with what we have."

Most observers say the solution lies in both addressing the recall process and rethinking how recalls are communicated. That includes examining the terminology. In the United Kingdom,

the word "recall" is used only for products that have caused, or are likely to cause, deaths or very serious injuries. Lesser cases are termed corrective actions; they can be addressed via consumer education or minor fixes, like the tubes of oil offered by Dorel. The adoption of more nuanced wording has been proposed repeatedly in the U.S., but government officials involved in recalls say that such a system is too risky because it might prompt

CONTINUED ON PAGE 151

## Improving Your Powers of Recall

**Six government agencies oversee product recalls, creating a morass for consumers hoping to determine if something they own has been pulled from the shelves. There's a good chance they do: Half of U.S. households are likely to own a product that's been recalled in any given year. Here are strategies to make your home genuinely safer.**

### STUFF YOU ALREADY OWN

Start by performing triage: Identify products, such as car seats or ATVs, that are most likely to pose an immediate danger if defective and see if they are listed at recalls.gov (or simply enter the brand and model into a search engine along with the word "recall"). A growing number of apps, blogs, Facebook pages, and Twitter feeds also announce recalls.

### STUFF YOU PLAN TO BUY

Register all new purchases with the manufacturers. (You're not required to provide demographic information; basic contact info is fine.) Alternatively, you can register them with various recall-tracking entities; the CPSC offers such a service, as does wemakeitsafer.com.

### RECALLED POSSESSIONS

In many cases, just knowing about the problem may help you avoid it. After assessing the risk posed by recalled products I owned, I decided to ignore topple-over warnings for a toddler's chair, send for the fix offered for our kid's bike trailer, and replace the childproof locks on our kitchen cabinets. One thing you can't do: sell your recalled gear. That's illegal.

### EVERYTHING ELSE

The majority of injuries aren't the result of product defects but consumer misuse. Learn how to properly secure your pool fence, use that new power tool, and install your child's car seat—improper installation is the single greatest danger children riding in them face.



## Knows All the Angles

This Father's Day, get Dad something better than a tie. General's affordable Digital Sliding T-Bevel is the only one of its kind on the market, and propels this classic tool — and Dad's woodworking, home renovation, and DIY projects — into the 21st century. Available for purchase at your local home center, select internet retailers, or at [generaltools.com/digital](http://generaltools.com/digital).



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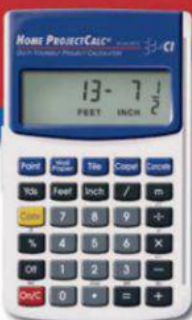
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*THE 2012 POP MECH  
TOP SHOP HONDA PILOT  
GOES WEST COASTAL*



**STORMING  
THE**







**Last month, we left Galpin Auto Sports (G.A.S.) burning some serious midnight 5W30 (biodegradable G-Oil, specifically) to finish the Top Shop Honda Pilot in time for our shoot. Vimby (Video In My Backyard), our reality videographers who are shooting a TV pilot of the making of this Pilot, had the cast and crew booked weeks in advance. Finished or not, the Pilot had to roll.**

Failure isn't an option at G.A.S. When something doesn't exist, G.A.S. fabricates it. The lift kit is an example: To fit oversized tires and level the Pilot at the same time, G.A.S. worked with ReadyLift to develop 2-inch front coilover spacers and 1-inch-tall rear strut extensions.

Raising the Pilot's center of gravity makes its ride more mushy than its cushy factory quality. G.A.S. wanted crisper handling in conjunction with the lift. Unfortunately, Pilot and performance aftermarket are mutually exclusive. As crunch time arrived, Bilstein and G.A.S. slaved away to create firmer, high-pressure nitrogen struts with valving and dimensions for one of the few lifted Pilots on the planet. As shoot day approached, we knew the show must go on, even if our star wasn't at 100 percent. G.A.S. came through, which is why they're our 2012 Top Shop.

## PRODUCTION ASSISTANCE

Our original plan called for a uniquely Southern California adventure. We would pick up the Pilot and piggybacked Honda NC700X sport bike at G.A.S. for a red-eye departure to Big Bear, then hit the slopes near opening time for some late-season spring snow-boarding. After lunch, we'd apex down the mountain. Bilstein-bolstered cornering and Ride Rite Coil-Rite rear air springs to support the bike's weight would help us make time. Traffic willing, we'd be in Newport Beach for some pre-sunset surfing. In the likely event of gridlock, the Pilot could be parked and the NC700X unloaded, and we could split-lane to the coast. Success: snow and sand in the same day.

This Pilot was created with that uniquely Southern California lifestyle in mind. Earth doesn't have many places to ski and



LEFT

Softer than Corinthian, perforated Barracuda leather in Light Gray and Dark Charcoal gives the Pilot a racy look and luxurious feel.

ABOVE

G.A.S. had a blast making an enclosure for the Kicker Solo-Baric square 10-inch subwoofers. The custom fiberglass panel, contoured to match the dashboard, is their version of cranking it up to 11.

G.A.S. mounted the Escort 9500ci radar/laser detector on the dash so it'd be unobtrusive but easy to see.

We decided to go green: G-Oil Advanced Full Synthetic uses rendered animal fat to lubricate our Honda 3.5L i-VTEC V-6. This oil meets API standards and is highly biodegradable.





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**PROGRESSIVE**





Pro boarder/DJ/model Pat Millin does his own stunts. He shook down the first Honda NC700X in the U.S. prior to our coastal cruise.

That's a hands-full thumbs-up. For a hybrid commuter/canyon-carver, NC700X has best-in-class handling, according to European testers who've spent time on the bike.



LEFT

RIGHT

surf in the same day. At an early production meeting, this concept was described as "total full-on shred, dude."

Vimby's Central Casting division found the talent to turn this California fantasy into reality. Pat Millin and real-life girlfriend Nicole Herold were booked to portray the stereotypical young, active Southern Californians whom this Pilot appeals to (and whom the rest of the country tends to envy). It wasn't a stretch. Pat currently ranks in the top 25 in the world in the Ultimate Boarder standings. Billed as "the only boardsports triathlon in the world," Ultimate Boarder combines surfing, skateboarding and snowboarding.

For Pat's extreme lifestyle, this Pilot abides. Its Yakima roof-top cargo system is board-ready. The SkyBox Pro 12 model (which was Onyx before it was painted Dupli-Color Championship White matte pearl to match the Pilot) can handle items up to 92 inches long—plenty of space for Pat's snowboard. His Matuse wetsuit and a

variety of other road trip gear were stowed safely in the SkyBox, thanks to its cargo-net/interior management features. Pat's J7 surfboard was strapped securely next to the SkyBox on the Pilot's roof rack, standard with Honda's Touring package.

In the cargo area, G.A.S. removed the third-row seat and made a custom console for Kicker subwoofers. If this enclosure wasn't occupied by wires and Kicker components, it could conceivably store Pat's skateboard, or even a small set of golf clubs. Other logical road-trip stowaways in the cargo area are parts and accessories such as spare headlight bulbs from [RockAuto.com](http://RockAuto.com), Mechanix Wear M-Pact Gloves, a BlackFire Clamplight free-standing utility light and a quart of biodegradable G-Oil Synthetic.

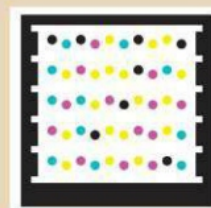
With the props loaded and locked, the talent took center stage. Our stunt driver, Pat, is no stranger to magazine pages. He can now add *Popular Mechanics* to credits that already include *Surfer's Journal* and *Outside*.



## PLATINUM-GRADE CLEANING AND SHINING

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Pat's girlfriend Nicole is also an on-camera veteran. Although this is the first Pilot shoot she's done, Nicole has already achieved every over-40 pop-culture vulture's dream: She was on the cover of *Rolling Stone*. Granted, Kid Rock shared Nicole's lime-light, but at least she got to see her picture on the cover and possibly buy five copies for her mother, as the old Dr. Hook and the Medicine Show tune gloated.

The Pilot also plays into Nicole's active lifestyle. As a fitness model, her cover credits include *Men's Journal*, and she's appeared inside *Shape*, *Stuff* and *Cosmo*. Should Nicole happen to run into a producer or casting agent at the beach, she could conceivably flip down the Pilot's rear-facing 12-inch Audiovox monitor and show digital images of her portfolio, or play her screen-test reel.

Basically, our Top Shop Pilot was built for active Southern California couples like Nicole and Pat, particularly ones who have kids.

### CLEARED FOR TAKE-OFF

A few of the Pilot's nuts and bolts were still hot when our cast and crew arrived at G.A.S. on road-trip day. Our co-star, the Honda NC700X bike (the first one in the U.S.), arrived from the South at zero hour. Its plastic parts were painted Dupli-Color Championship White matte pearl to match the Pilot. To transport the bike, G.A.S. beefed up a Joe Hauler receiver-mounted rack with an aluminum diamond-plate floor panel. An extra under-vehicle bar to support the 600-plus-pound bike and rack was added for extra insurance, as was a Progressive Insurance motorcycle policy.

The tag-along bike idea pays homage to Lamborghini, as does the Pilot's paint job, which is inspired by the Bianco Canopus matte pearl white color on the current Gallardo and Mercielgo. The legendary Lamborghini LM002 set the onboard bike precedent.

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Affectionately called the “Rambo Lambo,” about 328 LM002s were built between 1986-1993. Lamborghini aspired to sell these V-12-powered SUVs for military use in the Middle East. Qaddafi allegedly ordered 100 for the Libyan army, although none ever saw action as far as any living sources know. Instead, LM002 ownership was a who’s who of terrorists and A-list talent: Uday Hussein, Pablo Escobar, Mike Tyson, Malcolm Forbes, Sylvester Stallone, Eddie Van Halen and even former Cycle World and *Rolling Stone* contributor Hunter S. Thompson.

In the 1980s, one of the enthusiast magazines featured an LM002 that was allegedly built for an oil sheik. It included a small dual-sport bike that mounted in the cargo area. The apparent logic: If the V-12’s six Weber carburetors sucked the 76-gallon gas tank dry during an extended desert expedition, the bike could be ramped down the tailgate James Bond-style so the adventure could continue. Our Pilot’s Joe Hauler hitch-mounted sport bike is a more accessible take on that oil-royalty concept.

Pat, who does his own stunts, took the Honda NC700X for a shake-down ride prior to loading it up. He twisted around Los Angeles’s officially unofficial test track, Mulholland Drive. This road basically connects the Hollywood Bowl to the Pacific Coast Highway in Malibu some 55 windy miles later (with the exception of “Dirt Mulholland,” an 8-mile unpaved section that was gated to prevent motorized travel). The asphalt



ABOVE

Mulholland is the traditional two-wheeled proving ground in Los Angeles. On any given Sunday, at least one example of almost every worthwhile motorcycle can be seen on this road.

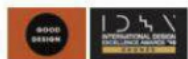
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LEFT

Pat and Nicole hit the sand for fun and profit, not just on our Pilot shoot but also for work. Pat surfs professionally and Nicole is a model and actress who shoots frequently on the sand.



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resumes in Woodland Hills and twists through the Santa Monica Mountains for about 30 miles before terminating at Leo Carillo State Beach.

Mulholland is a motorcycle mecca, as enthusiasts around the world are well aware. Sundays feature a cavalcade of celeb cyclists. The Rock Store, on Mulholland between Agoura Hills and Malibu, is a favorite two-wheeled hangout for Jay Leno and Arnold Schwarzenegger. The Snake, Mulholland's tightens chicanes, is a couple of miles from The Rock Store are one of the most dangerous—and most photographed—sections of Mulholland.

We had to get our show on the road, so Pat didn't get to do the first full traverse of Mulholland on an NC700X. However, leaning through a few miles of Mulholland earned this adventure bike some L.A. street cred. Its 670cc parallel-twin engine with a longish 80mm stroke punctuates low-end and mid-range power. Our NC700X came with the standard 6-speed automatic transmission, giving the bike about a 240-mile cruising range from its 3.7-gallon tank. That and about six inches of front and rear suspension travel make it and our street/sand Pilot an adventurous twosome.

As we spent our final few minutes dialing



in the last of our Pilot's updates, our itinerary changed. Southern California shredding was out; Central California surfing, ranching and milestoning was in, as we'll explain. Hitched up and ready, our adventurers departed G.A.S. for the beach. We didn't subject Pop Mech's New York contingent to America's "Ventura Highway" on the Kicker-boosted stereo system while navigating the namesake 101 Freeway. About an hour later, we merged with California State Route 1, the Pacific Coast Highway (simply PCH in the local dialect). Our first glimpse of the Pacific was at Port Hueneme (pronounced WHY-nee-mee; why ask why?). This is the port of entry for many imported vehicles in the western United States. Our Honda Pilot was actually assembled in Lincoln, Alabama.

Our first photo shoot was at Pismo Beach. Normal PCH coastal cruises stop in Santa Barbara. Although it has famous surf

## ON THE GO!

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**2012  
HONDA PILOT  
TOURING**

**ENGINE TYPE:**  
3.5L V6

**VALVETRAIN:**  
24-Valve SOHC VVT

**HORSEPOWER/TORQUE:**  
250 @ 5,700 rpm;  
253 @ 4,800 rpm

**TRANSMISSION:**  
Five-speed automatic

**SUSPENSION:**  
MacPherson strut front,  
multi-link rear with  
trailing arms

**WHEELS:**  
18 in. alloy

**TIRES:**  
P235/60R18

**WHEELBASE:**  
109.2 in.

**LENGTH:**  
191.4 in.

**HEIGHT:**  
72.4 in.

**WIDTH:**  
78.5 in.

**CURB WEIGHT:**  
4,414 lb.

**TOWING  
CAPACITY:**  
2,000

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ECONOMY,  
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18/25/21 mpg**

**FUEL CAPACITY:**  
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Mount



Handlebar Seatpost  
Mount



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### RIDING ON AIR

Firestone's Ride-Rite line of air helper springs helps haul loads more safely. While these products don't increase load-carrying capacity, they do improve ride quality and help stabilize the vehicle. Increasing or decreasing pressure in the air spring adjusts the ride for varying load and road conditions. The Coil-Rite kit used here installs inside the rear coil springs in about an hour. These air springs supply up to 1,000 pounds of load-leveling capacity.

[firestoneindustrial.com](http://firestoneindustrial.com)



breaks, Santa Barbara's beaches aren't pristine. Vast offshore oil reserves dwell near this part of the coast. The current drilling moratorium means that no new offshore oil platforms will dot the horizon between Ventura and Santa Barbara.

So, the naturally occurring crude bubbles up from the ocean floor and washes onto Santa Barbara's beaches. University of California at Santa Barbara students are easily identified by their tar-caked feet. Apparently it's more environmentally responsible to transport thousands of troops and gear to the Middle East and escort oil tankers with battleships than to erect more unsightly oil platforms.

Our Pilot plays a small part in petroleum conservation. Its EPA fuel economy is top-of-class at 25 freeway MPG. Variable Cylinder Deactivation technology in Honda's 3.5L V-6 helps: Under light load, fuel and fire are cut to certain cylinders; all six are activated for passing, towing and other maneuvers that require full power. (The Honda NC700X also has impressive economy at about 60 MPG.)

Another "green" move is a reusable K&N air filter, which can be cleaned and re-oiled as necessary—instead of being banished to a landfill.

Continuing our green theme, we filled the Pilot's crankcase with G-Oil Bio-Based Advanced Synthetic. Green Earth Technologies formulates this oil from animal fat, the original automotive lubricant, pre-dating fossil-fuel drilling and refining.

G-Oil Advanced Full Synthetic is also renewable and highly biodegradable. Although it should be recycled like conventional oil, any accidental G-Oil drips and spills are much less toxic to groundwater and marine life.

Politics and profits aside, we tried to set an environmentally conscious example at biologically sensitive Pismo Beach. Technically known as the Oceano Dunes State Vehicular Recreation Area, this is one of the last remaining chunks of California beach where vehicular travel is allowed. Its 5.5-mile Sand Highway is fairly firm, al-

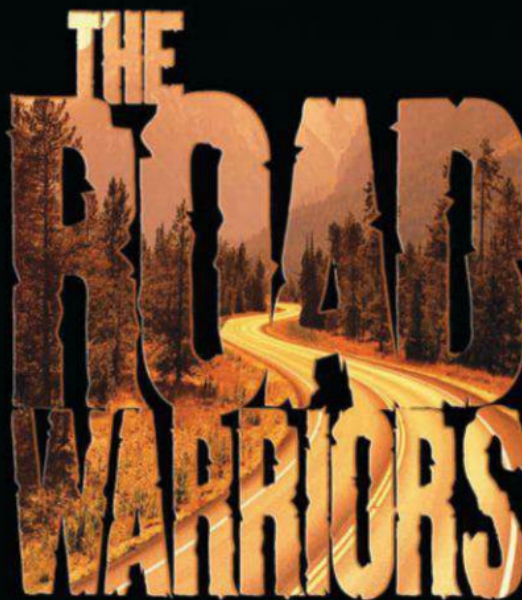
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lowing dune-camping access for vehicles and RVs. Still, we were happy that the Pilot has increased traction and more ground clearance, thanks to 30.5-inch-diameter P265/50R20 Nitto Terra Grapplers. Because our road trip isn't limited to paved roads, we needed an all-terrain pattern that could evacuate sand and mud via pronounced voids between the tread blocks. We didn't want to compromise highway manners, however. Reinforcement bars between the lugs control tread flex during cornering. The Terra Grapplers are also far quieter than their aggressive stance suggests—not that tire hum is much of a factor in a vehicle with a few thousand extra watts of Kicker power.

The all-terrain pattern-clawed its way through the hard-packed sand, no airing down for a wider footprint necessary. We didn't drive deep into the 1,500 acres of drivable dunes with our heavy Pilot. Instead, Pat and Nicole took the opportunity to play in the Pismo surf and do some hiking—many of the Pismo dunes are closed to motorized activity so the endangered Western Snowy Plover bird can nest.

Because sand and saltwater aren't sheetmetal's best friends, our first post-Pismo stop was the closest car wash. Pat and Nicole proceeded to give the Pilot the vehicular equivalent of a Central California spa treatment: Once the briny film was hosed off, the couple treated the Pilot's new paint to a protective coat of Turtle Wax ICE Liquid Polish. Tires and wheels were cleaned with Turtle Wax Platinum All Wheel and Tire Cleaner; rubber was protected with Platinum Tire Shine with Wax.

Next location: the infamous Madonna Inn in San Luis Obispo. Its steakhouse is worth the trip alone, but the inn's claim to fame is its theme rooms. Often imitated, the Madonna Inn might be the first hotel to have a Jungle Rock room, a Caveman room and many other festive variations. Its kitschy elegance makes the Madonna Inn a mandatory photo location on California's Central Coast.



|               |                                                                                                                                                                         |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TOP</b>    | Pat is used to using wax on his boards, so applying Turtle Wax ICE Liquid Polish was second-nature to him.                                                              |
| <b>BOTTOM</b> | Saltwater obviously isn't sheetmetal's best friend. After beach-blasting, Pat and Nicole gave the Pilot the vehicular equivalent of a Central California spa treatment. |

# BIG WEEKEND?

Obviously you're not going to haul enough stuff to take care of *everybody* that might show up this weekend. But when you're faced with a heavy load, you still have to live with the ride of your truck. It's simple. Just add air to the Firestone Ride-Rite™ and R4Tech™ air spring suspensions. They control the load, maintain that great ride, and stabilize the vehicle.

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The Madonna Inn in San Luis Obispo is a Central California landmark. Distinctively decorated rooms make it an infamous honeymoon and anniversary destination.

The historic hotel inspired Pat to rip a few ollies and caspers in its parking lot.



## HEARST ESTATE

Our ultimate destination: the Hearst Castle and Ranch off Highway 1 (PCH) in San Simeon. The castle actually lives up to its billing, rivaling bona fide European versions. Featuring a 115-room main house plus guesthouses and an eight-acre garden, the Hearst Castle was publishing magnate William Randolph Hearst's 30-year "in-the-works" masterpiece. He transformed a family camping getaway into a palace that hosted Hollywood's A-list as well as President Coolidge and Winston Churchill. The Hearst family donated the castle to the California State Parks Department in 1958. The state conducts four different guided tours of the castle, making it difficult to see everything in one day.

We also got a rare invitation to tour the Hearst Ranch. The land surrounding the castle is still owned by the Hearst Corporation. Patriarch George Hearst was a successful miner who bought 40,000 acres of

Central California nirvana in 1865. Twenty years later, his parcel had grown to 270,000 acres.

Today, Hearst Ranch is 80,000 acres surrounding the Hearst Castle. The ranch specializes in free-range, grass-fed cattle that's Food Alliance certified. Angus and Hereford are the two prominent breeds.

Sustainability is the ranch's mantra. Although one pasture is irrigated, the rest of the land is au natural. The herd is limited to about 1,500 head to lessen the impact on the land. Hearst Ranch claims that stress-free, grass-fed beef that has an ocean view tastes better. It also contains more beta carotene, vitamin E and omega-3s than non-grass-fed beef.

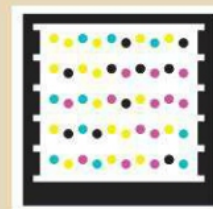
The ranch also has remnants of the Hearst Zoo. It was once the largest private zoo in the world, with over 300 hundred animals. Herbivores roamed the hills freely. Although we didn't have any chance encounters with zebras or sambars, the Vimby video crew



## GREEN OIL

G-Oil is a line of API-certified motor oils blended from renewable U.S. feed stocks. The oil is also billed as biodegradable. G-Oil's manufacturer, Green Earth Technologies, claims that its Advanced Full Synthetic blend offers 67-percent less Global Warming Potential than conventional motor oils. Further, the company estimates that replacing one percent of conventional motor oil with G-Oil Advanced Full Synthetic would be the carbon-footprint equivalent of planting 2.8 million trees.

[getg.com](http://getg.com)



## ON THE GO!

GoPro HD Hero 2 cameras were used to document the vehicle build and ensuing trip. Here's one suction-cupped to the Pilot.





# GIVE DAD THE BRIEFCASE THAT WILL NEVER GO OUT OF STYLE



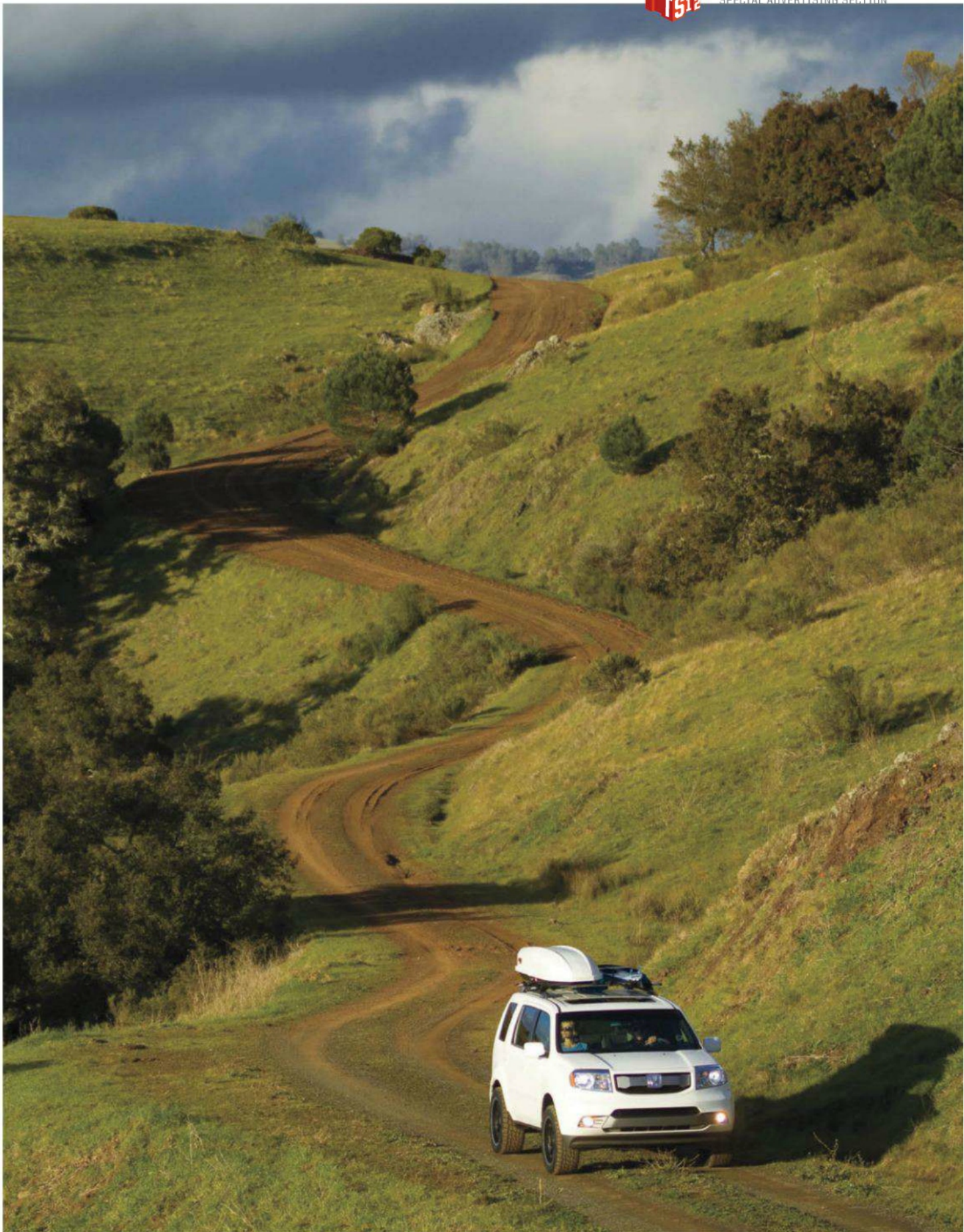
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had portable GoPro Hero HD2 action cameras ready to roll just in case. Here again, the Nitto Terra Grapplers helped us explore the unpaved roads without fears of flats or getting stuck in the moist dirt.

Sebastian's General Store across from the Hearst Castle is tough to beat for great eats in San Simeon.

TOP

A quick tie-down time-out to secure the surfboard before heading to Hearst Castle.

RIGHT

Taking a break from shooting the Pilot, Sebastian's General Store and Café served as our craft services. It's unpretentiously epicurean; we stopped mainly because Sebastian's is across the street from the Hearst Castle. Wine connoisseurs, who flock to California's Central Coast, now have Sebastian's on their GPS since the store also houses the fairly new but buzz-gaining Hearst Ranch Winery tasting room. We were driving and on a tight shooting schedule, so we didn't partake.

### BACK TO REALITY

As the sun set over San Simeon, we called our shoot a wrap and banzai'd back to L.A. The Pilot's Escort radar detector helped us get our flow-in crew back to

**ESCORT**  
DRIVE SMARTER™



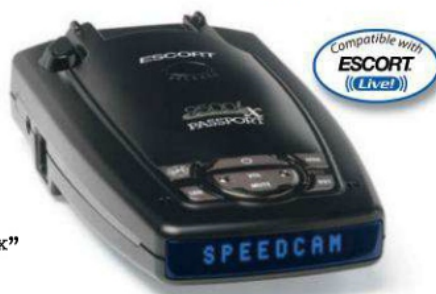
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**2012 TOP SHOP  
ROAD TRIP**



The pilgrimage is complete. The Hearst Castle, photographed here from the Hearst Ranch is the undisputed crown jewel of the American publishing industry. Visiting the Hearst Corporation's ranch in the Pilot is a fitting way to celebrate The Hearst Corporation's 125th anniversary.







San Simeon Sound Of Music?  
The hills would definitely come  
alive if the Pilot's hatch were  
lifted and its stereo cranked.

the airport on time—no  
wrap party unfortunately.

At the trip's end, our  
Pilot shoot rated high for all involved. The  
SUV isn't an in-your-face vehicle. Instead,  
all of its electronic subtleties, such as an  
Audiovox Car Link Smart Phone-activated  
remote-starting system, make it a project  
that demands a second look—and a sequel.

Readers who have a chance to see the  
vehicle and bike in person will appreciate  
all of the attention to detail that G.A.S.  
engineered into a model that doesn't have  
a thriving aftermarket for accessories. Fans  
will undoubtedly want to shoot themselves  
next to the 2012 Pop Mech Top Shop Pilot.

## WHERE TO SEE THE CAR & BIKE

### Route 66 Rendezvous

September 13-16  
San Bernardino, CA

### SEMA Show

October 30-November 2  
Las Vegas, NV

## FOR MORE INFORMATION

### Galpin Auto Sports (G.A.S.)

877-GO-GAS-GO  
[galpinautosports.com](http://galpinautosports.com)

### Hearst Castle

800-444-4445  
[hearstcastle.org](http://hearstcastle.org)

### Madonna Inn

805-543-3000  
[madonnainn.com](http://madonnainn.com)

### Oceano Dunes State Vehicular Recreation Area

805-773-7170  
[ohv.parks.ca.gov](http://ohv.parks.ca.gov)

### Sebastian's General Store and Cafe

805-927-3307

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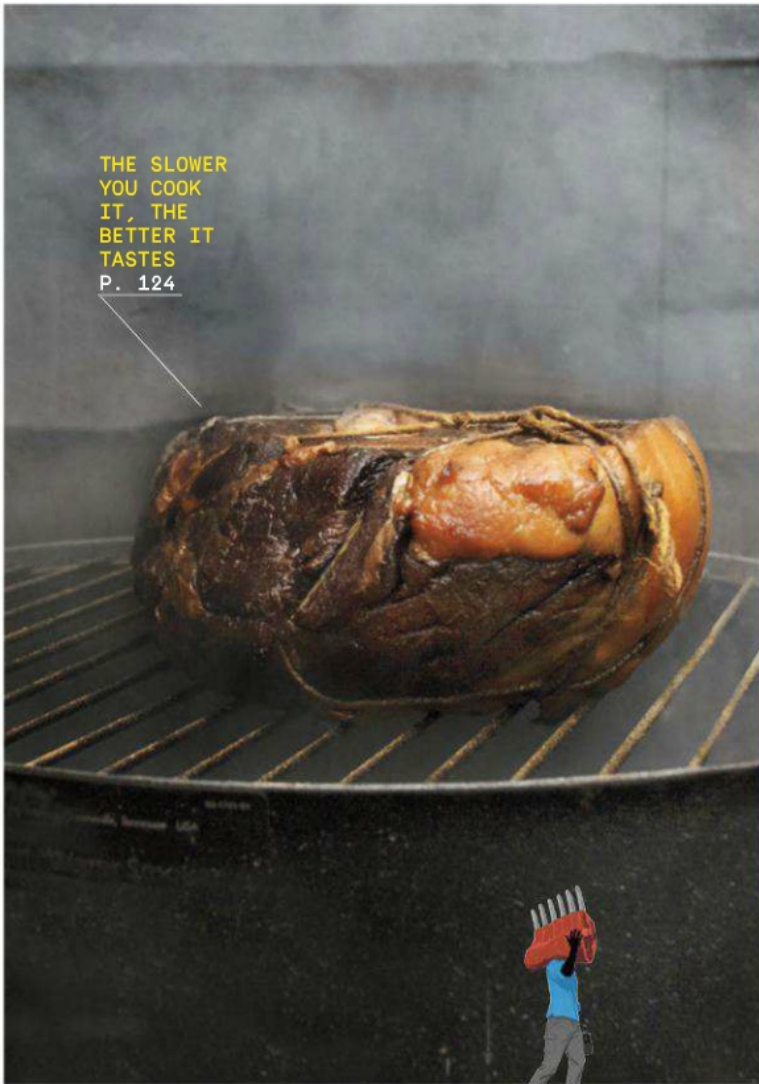
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**THE MYSTERY** of blistering, crumbling plaster walls—solved! [p. 139](#)

THE SLOWER  
YOU COOK  
IT, THE  
BETTER IT  
TASTES  
[P. 124](#)



EXPERT ADVICE

**DIY ADVENTURE:**  
BUILD A  
PUMP TRACK  
Carve out a backyard  
BMX course and cyclists  
will flock to it! [p. 123](#)

**EARLY ADOPTER:**  
THE BOTTLE  
ROCKET  
DIY for kids! A simple  
project teaches Newton's  
third law. [p. 132](#)

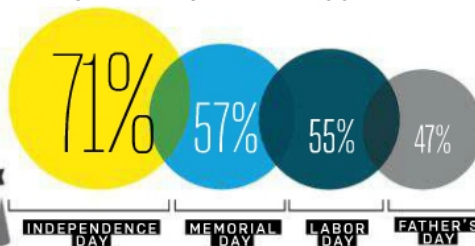
**Q+A**

Our pros answer  
your toughest tech,  
home, and auto  
questions.

[p. 136](#)



**MOST POPULAR GRILLING HOLIDAYS**  
A survey of 29,000\* yielded these top picks.



GLOSSARY

GRANITE KISS

While you're building a rock wall, two stones try to meet, but your fingertip gets in the way. This is a granite kiss. It hurts, but it goes with the job.

4

**W**  
weekend

TECH ADVENTURE HOME SCIENCE AUTO

THE GUIDE TO  
YOUR DIY LIFE



[p. 148](#)

**DIY TECH:**  
ULTIMATE  
LAPTOP DESK  
It's impossible to cram any  
more gear into this desk.  
We tried. [p. 116](#)

**TACTICS:**  
20 WAYS TO OPEN  
A BEER BOTTLE  
You could use a chain  
saw. But try these other  
methods instead. [p. 134](#)

**DIY AUTO:**  
20/20 HINDSIGHT  
Install a backup camera  
in your beater for a  
mere \$100. [p. 142](#)



diy

## Tech

- STREAMING MEDIA
- BRIGHT CAMERA STREAKS
- SOLDERING MISHAPS



BY GLENN  
DERENE  
AND  
ANTHONY  
VERDUCCI

## ULTIMATE LAPTOP DESK

WE HOT-RODDED AN ORDINARY DESK INTO A SUPERLATIVE LAPTOP (AND GAMING) STATION.

We took a slim, lightweight Dell XPS 13 Ultrabook (\$1000) and modified a desk with extra components to fatten up its functionality. Here's what we added.

Cooling stand + PlayStation 3 + Wireless keyboard + 3D screen + Drawing tablet + Speaker system + Optical drive + Charging dock + iPad mount



PM in-house geek Anthony Verducci routes cables under our modified desk using adhesive cord clips.

u

WEEKEND





## Modern laptops

are exercises in restraint. The trend toward super-lightweight, razor-thin ultrabooks has forced computer makers to jettison extravagances such as optical drives, large-capacity hard drives, extra ports, big screens, and multi-memory-card readers. Most of that stuff just weighed us down when we took our laptops on the road. But the thing is, when you sit at your desk, you sort of want it

all back. Optical discs may be a thing of the past, but we've got plenty of such things of the past sitting in our offices. Cloud storage for your files is nice, but a 2-terabyte drive on your desktop is even nicer. And a laptop with two USB ports is about four short of acceptable.

So we decided to make the best of both worlds. We took a Dell XPS 13, one of the sleekest, sexiest ultrabooks on the market, and designed a docking station that incorporated everything the computer was lacking and then some. The idea was to take a sturdy, generic desk from Crate and Barrel, then screw and strap a bunch of accessories onto it—a perfect marriage of home electronics and Home Depot.

We insisted on a few eccentricities that, frankly, made the project a lot harder. For instance, our 24-inch Sony PlayStation 3D display didn't have standard VESA mounting points to mate to our swing-arm Ergotron desk mount, so we drilled a few holes into a steel plate and fashioned our own adapter bracket. That allowed us to hide a PS3 under the desk and use the monitor for computing and 3D gaming. Why, you ask? Well, why not? If the Dell ultrabook demonstrates the elegance of understatement, the desk underneath it is our tribute to the awesomeness of overkill.

## MOD YOUR DESK

That "finished" piece of furniture you bought is a few holes, wires, ports, and outlets short of its cyborg ideal. Charge up your power tools.



1



2

### 1 START WITH THE BORING STUFF

Position your equipment where you want it on the desk. Group the gear around one or two spots where you can route all of your wiring, then mark those spots for drilling. Clear off the gadgets and tape the desk surface to prevent damage. A 1-inch holesaw will make an opening for five or six wires.

### 2 FREE YOUR MONITOR

This PlayStation 3D monitor was not made to be mounted, but we did it anyway, using a few semi-trustworthy anchor points and an Ergotron LX desk mount (\$170). A monitor on a swing arm is worth the trouble—it frees up desk space and lets you place your screen virtually anywhere.

### 3 EMBRACE THE UNDERBELLY

If you're trying to accommodate lots of stuff, try this tactic: We flipped our desk over and attached components (PS3, optical drive, extra USB ports) to the underside using plastic plumber's tape. When possible, we also used the desk's existing fasteners.

### 4 DON'T SKIMP ON OUTLETS

We needed a power strip, but we didn't want to see it. And don't you just hate it when surge protectors get crowded by large adapters? This 4-foot-long Tripp Lite strip (\$48) fixed both problems with 16 amply spaced outlets and mounting brackets that let you hide it under the desk.



4



3





A CELEBRATION OF AMAZING CREATIONS  
AND THE PARTS THAT MADE THEM POSSIBLE

# MAKE MUSIC WITH A WAVE OF THE HAND

## Build your own gestural musical instrument

●●● DIFFICULTY LEVEL:  
**ADVANCED**

Here's a great musical project that's also a fun way to learn about using an Arduino.

What's an Arduino? It's a small, inexpensive, programmable computer that can interact with sensors, lights, motors and just about any other electronics. It's a great way to give your project some smarts, and they're often used in robotics and a variety of creative, interactive projects.

Here we'll be using it to build an unusual musical instrument that you play with a wave of the hand. Such instruments are sometimes called gestural instruments, because one plays them by making physical gestures.

An early such instrument is the theremin, created in 1928 by Russian inventor Léon Theremin. This instrument has a distinctive, haunting sound, and was often used in the soundtracks of early science fiction and horror movies. Its pitch and volume are controlled by movements of the player's hands relative to a pair of antennae. During performance, the player never actually touches the instrument!

For our version of the theremin, the performance technique is similar, but the technology is different: while the original theremin measures the capacitance that varies depending on the distance between the hand and the antenna, our instrument uses sonar. It does this with the

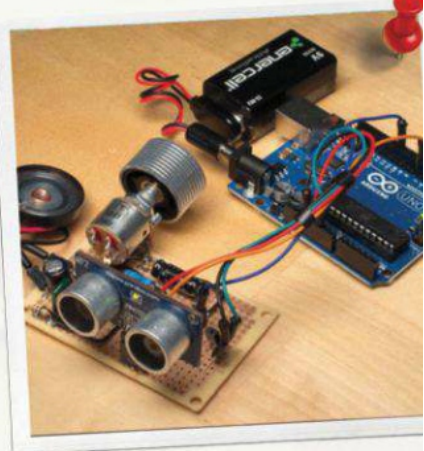
Parallax Ping sensor, which bounces ultrasonic signals off objects and measures how long it takes the signal to return to determine their distance.

### HOW TO PLAY

Once your "theremin" is up and running, it will sit silently as long as there is clear space a few feet in front of the Ping sensor. As you move your hand toward it, it will spring to life, and you will hear musical notes that vary as you move your hand closer and farther away. Unlike a traditional theremin, which plays a smooth varying pitch, our instrument will run through the distinct notes of a musical scale. Take your hand away, and the sound will stop.

### HOW DOES IT WORK?

The Ping sensor connects directly to input pins on the Arduino, and sends it distance information. The Arduino runs a program that translates that information into musical notes. The audio signal is sent out of the Arduino's output pins, boosted by a simple amplifier circuit and played through a speaker.



Parental supervision is strongly recommended when using power tools and solder. Always wear safety glasses. Avoid breathing fumes and always work in a well-ventilated area. Wash hands thoroughly after use. Follow all safety instructions on solder and soldering equipment packaging. California residents: WARNING: Soldering products contain, or when used for soldering and similar applications produce, chemicals known to the state of California to cause cancer and birth defects (or other reproductive harm).



## PARTS

- |                                                |                                                         |
|------------------------------------------------|---------------------------------------------------------|
| <input type="checkbox"/> Arduino Uno           | <input type="checkbox"/> .1uF Capacitor                 |
| <input type="checkbox"/> Parallax Ping Sensor  | <input type="checkbox"/> .05uF Capacitor                |
| <input type="checkbox"/> Multipurpose PC Board | <input type="checkbox"/> 10-ohm 1/4 W Resistor          |
| <input type="checkbox"/> Breadboard            | <input type="checkbox"/> LM386 Amplifier                |
| <input type="checkbox"/> Jumper Wire Kit       | <input type="checkbox"/> 100K Audio Taper Potentiometer |
| <input type="checkbox"/> 8-ohm Speaker         | <input type="checkbox"/> Silver Tone Knurled Knob       |

You can think of this as two separate projects: the first is to program the Arduino and hook it up to the Ping sensor, and the second is building the amplifier circuit.

### PROGRAMMING THE ARDUINO

Arduinos are designed to make learning how to use them as easy as possible. A lot of documentation and great tutorials are available online. However, it can take some time to get the hang of it, so be patient and focus on one thing at a time! To help out, we've provided a pre-written "theremin" program you can download and install. To help out, we've provided a pre-written "theremin" program you can download and install. Scan the QR Code to learn more.

### BUILDING THE AMPLIFIER CIRCUIT

This is a handy circuit you can use for many different audio projects, and at its heart is the LM386 Amplifier. This project can be built on a solderless breadboard, or by soldering components on to a circuit board.

This project can be a great starting point for building your own unique musical instrument. The Arduino is an incredibly versatile device, and the possibilities are truly endless!

By Ken Murphy

MAKE MUSIC FEATURES  
THESE  RadioShack. PARTS:



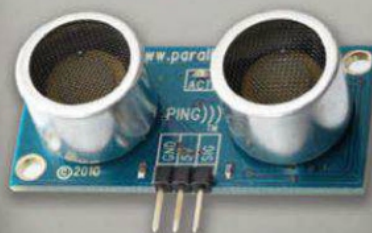
Arduino Uno



Silver Tone  
Knurled Knob



Audio-Taper Potentiometer



Parallax Ping Sensor

To see "how-to" video footage for this project and explore other great creations, visit [RadioShack.com/DIY](http://RadioShack.com/DIY)



SCAN THIS QR CODE  
TO LEARN MORE





## DIY TECH

## HOW MUCH GEAR CAN WE FIT ONTO A SINGLE DESK?

**Sony PlayStation 3D Display** \$500

• The monitor for our laptop and PlayStation shows games in 3D or gives two players separate views.

**Wacom Intuos5 (Large)** \$470

• Both a touchpad and a pen-input tablet, with 102 square inches of work area.

**Twelve South HoverBar** \$80

• This gooseneck mount clamps to a desk and suspends your iPad in midair.

**Microsoft Bluetooth Mobile Keyboard 6000** \$90

• A two-part keyboard saves space—stow the number pad when you don't need it.

**Tursion Unimax Charging Dock** \$39

• This charger has four interchangeable ports for smartphones, iPods, etc.

**Western Digital 2TB My Book** \$130

• A USB 3.0 hookup to massive amounts of storage.

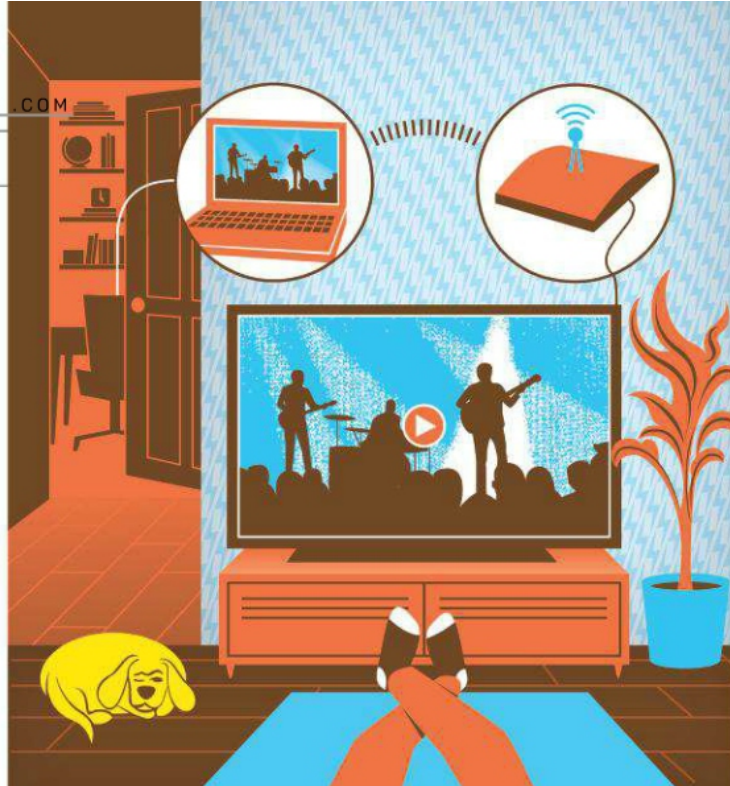
**Optical drive (\$32) and card reader (\$22)**

• We went the bargain-basement generic route on these components, then hid them beneath the desktop.

**Macally EcofanPro** \$40

• This beautiful bamboo laptop stand has an integrated cooling fan.

A quick-and-easy setup of hardware and software can get you streaming movies and music from your computer to your home theater.



## Digital Clinic

BY  
JOHN HERRMAN

ILLUSTRATION BY PARLIAMENT OF OWLS

## Interpretation of Streams

Nearly every video, song, and photo I have lives on my computer. My TV is in the living room—across the house. What's the easiest way to bridge the two?

You need three things to transfer media across your home. The first is a media source, or server, which you already have—your computer—that has all the videos, music, and photos on it. The second thing you need is a receiver of some sort that supports the Digital Living Network Alliance (DLNA) standard. If your TV is a relatively new "smart" TV equipped with Wi-Fi, it can probably act as a media receiver; if not, you'll need to attach an external one. The Western Digital WD TV Live Streaming Media Player is a good option and is available for about \$100 on Amazon. It supports Netflix, Spotify, and Hulu in addition to local file streaming. (More popular products, such as the Apple TV and the Roku box, can stream audio and video from online sources but can't play media files stored on a home network.) Both the Xbox 360 and PlayStation 3 also support local media streaming, along with a full complement of Internet streaming services.

The third thing you need is a translator—that is, software to take



W

WEEKEND





PROMOTION

# PopMech Used Car Checklist

Presented by **Mobil 1**

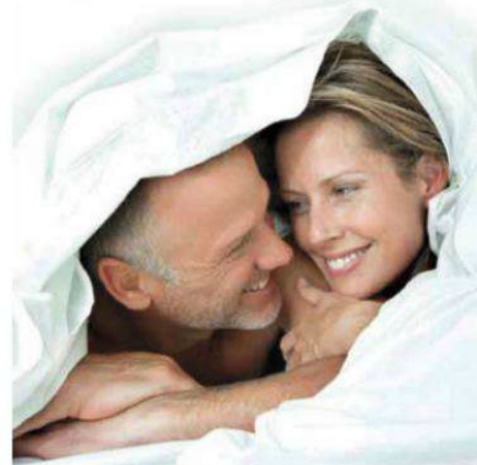


This is the iPhone app every vehicle shopper needs before stepping onto a used car lot. The 101 questions in the Used Car Checklist will help you spot everything from major transmission headaches to subtle but annoying electrical problems. The app walks you through an inspection, helping you come up with a letter grade for every car you consider. Take notes, store photos, and save multiple cars. The Popular Mechanics pros who built the Used Car Checklist can't tell you whether to buy a car, but they can help you make a smart decision.

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## DIY TECH / DIGITAL CLINIC

your media and make it visible to your streaming box. Windows can stream some video types natively via a feature called Windows Media Center, but you're far better off downloading a free app called TVersity. This will make your media visible to any DLNA device or game console and, if necessary, convert the files to a format your device can read. (In order for this feature to work, you'll need a fast processor—at least a Core 2 Duo.) As a bonus, TVersity can stream to your mobile devices, as long as they're connected to your home Wi-Fi network.

Mac users using a DLNA TV or streaming box should download an app called TwonkyServer, which will immediately make your media collection visible to your streaming device. PS3 or Xbox owners will be better served by the now-free Rivet application, which will stream your content and also retain your computer's folder structure.

Wireless speed is also important. Even if your router claims to transfer data at a full 54 megabits per second—the top speed of 802.11g routers, which is theoretically more than fast enough to stream an HD video—signal fluctuations can reduce that data rate drastically. You don't really notice the difference when you're surfing the Web; you do notice it when you're subjecting the connection to a steady load. File-sharing apps such as BitTorrent are a common cause of speed fluctuations, but distant router placement can cause problems, too. If your Wi-Fi video streams are getting choked, it might be time to consider upgrading to a faster 802.11n router or, better yet, rolling out some Cat 5e Ethernet cable.

### Update Overload

**I love Facebook and I love my cousin, but sometimes his updates are a little . . . much. I don't want to unfriend him, but it's getting obnoxious.**

It's possible to mute your Facebook friends without notifying them. If you hold your mouse cursor over your cousin's picture in a status update, a miniprofile should appear with a drop-down menu button. Select Settings from that menu and then you can customize how many updates you'll receive from him. You'll still be able to check his profile whenever you want—say, before the next family reunion—but his updates won't clutter your main feed. **PopMech**

## Don't Be an Idiot

### NEVER SOLDER HEADPHONE CABLES



With enough flux, patience, and time, any two wires can be soldered together. But my experience on a recent Saturday exposed the folly of trying to experiment with modern earbud cables. I wanted to join my high-quality JH Audio in-ear headphones with the highly use-

ful inline controller found on the cord of iPhone earbuds. So I snipped the earbuds off Apple's cable and stripped back the sheath, which revealed stranded wires of such gossamer thinness that a stray breath could move them out of position. Stripping the JH Audio cables released a

similar spiderweb of thin wire. What was intended to be a 5-minute project turned into a 45-minute mess of frayed wire, melted insulation, shaky hands, and sloppy soldering. Now I have nothing to show for my work except two destroyed sets of earbuds. Bummer. — GLENN DERENE



**GOT A TECHNOLOGY PROBLEM? ASK GLENN ABOUT IT.** Send your questions to [pmdigitalclinic@hearst.com](mailto:pmdigitalclinic@hearst.com). While we can't answer questions individually, problems of general interest will be discussed in the column.

WEEKEND

ILLUSTRATION BY PATSWERK



diy

## Adventure



BY MICHAEL FRANK

INPUTS

**THE DIRT:** Clay loam or topsoil mixed with clay is best. A 40 x 30-foot area takes 27 cubic yards.

**HAND TOOLS:** Wheelbarrow, shovels, string and dowels for layout, a soil tamper.

**THE MACHINE:** Yes, this counts as an excuse to rent an earthmover.

Max. roller height = 18 in.

Min. pump track dimensions = 20 ft x 20 ft

Min. distance between rollers, measured crest to crest = 10 ft per 1 ft of roller height.

Radius of banked turn = 10 ft

Max. beam angle = 70°

## MCCORMACK'S TRACK TIPS

**DESIGN:** Avoid flat spots. "Every square inch should tilt up, down, or sideways, to keep momentum going."

**SITE:** Build on a 3 percent slope to avoid flooding. Got a flat lot? Dig French drains at the berms.

**CONSTRUCTION:** Pile dirt 50 percent higher than the

final dimension to account for compaction. Then carve out the contours. "It's almost impossible to get a nice shape by adding dirt. It's easier to move it."

**MAINTENANCE:** Run a sprinkler to lightly soak the track before each ride. Let it nearly dry, and then pedal like crazy to "burn in" a line.

**RIDING:** Ratchet the pedals in short quarter-turns and push down with your arms off the back-sides of rollers. Don't pedal continuously.

**WORKOUT:** The top priority is fun, but pump tracks also build MMA-worthy core strength and balance skills.

California pump-track builder Mark Weir.



## BUILDING A PUMP TRACK

BIKERCROSS MEETS BACKYARD IN THE DIY PUMP TRACK—ALL YOU NEED ARE DIRT AND TWO WHEELS.

Rent this!



A

ny kid who has built a bike jump has probably dreamed of something like a pump track, a loop of banked turns, rollers, and benches that can feel like a perpetual motion machine. Imagine a motocross circuit at one-tenth scale but meant for mountain bikes or a kid's BMX. When Mark Weir finished the pump track at his home in Marin County, Calif., local kids swarmed—and their dads asked Weir to build tracks in their yards too. Now he is working on a \$1 million version for nearby Stafford Lake. "Once you start, you have to realize the addiction that comes with it—all of a sudden you're more of a builder than a rider," he says. To get the advice laid out above for DIY builders, we turned to Lee McCormack, who wrote *Welcome to Pump Track Nation* and has created hundreds of tracks. **PopMech**



Joe Kohl-Riggs of Brooklyn, N.Y., inspects his ingenious slow cooker. After gathering the parts, he built it in just a few hours.

*diy*

## Home

- EARLY ADOPTER: BOTTLE ROCKET!
- 20 WAYS TO OPEN A BEER BOTTLE



BY ROY BERENDSOHN

*W*

WEEKEND

## COOKING WITH SMOKE

BY JOE KOHL-RIGGS

A STEEL DRUM AND A FEW PLUMBING PARTS MAKE UP THIS NO-WELD SMOKER. ADD MEAT AND SMOLDERING WOOD—AND PLAN TO FEAST!







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HEARST BOOKS



M

en can admit that they like making barbecue because it's not really cooking—it's a DIY project that ends with eating meat. After a few years of cooking with smoke, I got good at it. Then, after a few more years, I fancied myself a magician, shrouding my cheap cuts of meat in the mystery of secret-recipe dry rubs, brines, sauces, and blends of flavoring woods. But it wasn't enough. I wanted to own every step of the process. My landlord said no to raising livestock in the apartment, so that left building the smoker itself to express my rugged individualism. Online research led me to the ugly drum smoker, which rightfully enjoys a cult following. Using a 55-gallon steel drum and parts found in any decent hardware store, the design produces an exceptional smoker. Building it is like barbecue itself, turning modest ingredients into something truly satisfying.

## PARTS LIST

## BODY

- One 55-gallon steel drum, open head, no gasket or lining

## COOKING GRATE AND SUPPORTS

- Three ¾-in., 1-in.-long bolts and nuts; stainless steel
- Six flat washers, ¾-in. hole, 1-in. outer diameter; stainless steel
- One cooking grate, 21½-in. diameter (Weber part No. 7435; fits 22.5-in. kettle grill)

## INTAKE ASSEMBLIES

- Four ¾-in., 24-in.-long threaded pipe; Sched. 40 black iron
- Four ¾-in. close-nipple pipe fittings; Sched. 40 black iron
- Four ¾-in. locknut pipe fittings; Sched. 40 black iron
- Four ¾-in. 90-degree elbow pipe fittings; Sched. 40 black iron
- Four U-bolts, 2½-in. inside length (to fit ¾-in. pipe); ¾-in. threads; dual mounting plates; stainless steel
- Four ¾-in. ball valves; brass; female connection

## HANDLE

- One ½-in. close-nipple pipe fitting; Sched. 40 black iron
- One ½-in. flange pipe fitting; Sched. 40 black iron
- One ½- to ¾-in. reducing elbow pipe fitting; Sched. 40 black iron
- One ¾-in., 6-in.-long threaded pipe; Sched. 40 black iron
- One 5-in.-long spring handle with ¾-in. hole diameter; stainless steel
- One ¾-in. cap pipe fitting; Sched. 40 black iron
- Four ½-in., 1½-in.-long bolts and nuts; stainless steel

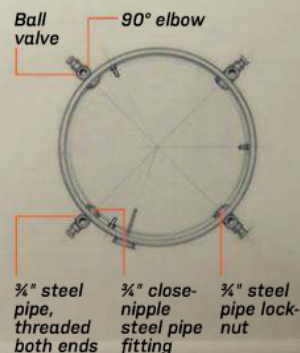
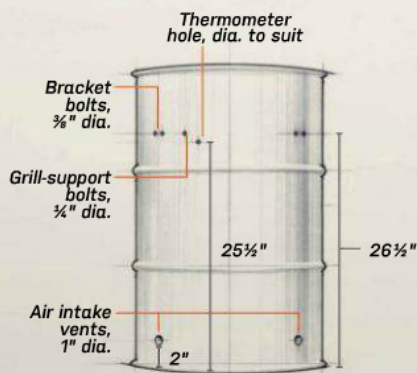
## FIRE BASKET

- One 12 x 48-in. piece of flattened, expanded metal; 1½-in. hole; 16-gauge plain steel
- One charcoal grate, 13½-in. diameter (Weber part No. 7440; fits 18½-in. kettle grill)
- Six ¾-in., 1-in.-long bolts and nuts; stainless steel
- 12 flat washers; ¾-in. hole, 1-in. outer diameter; stainless steel
- One length of 14-gauge wire; stainless steel

## OTHER

- One barbecue thermometer
- Eight plugs, ¾-in. pipe size; stainless steel

## Hole Placements





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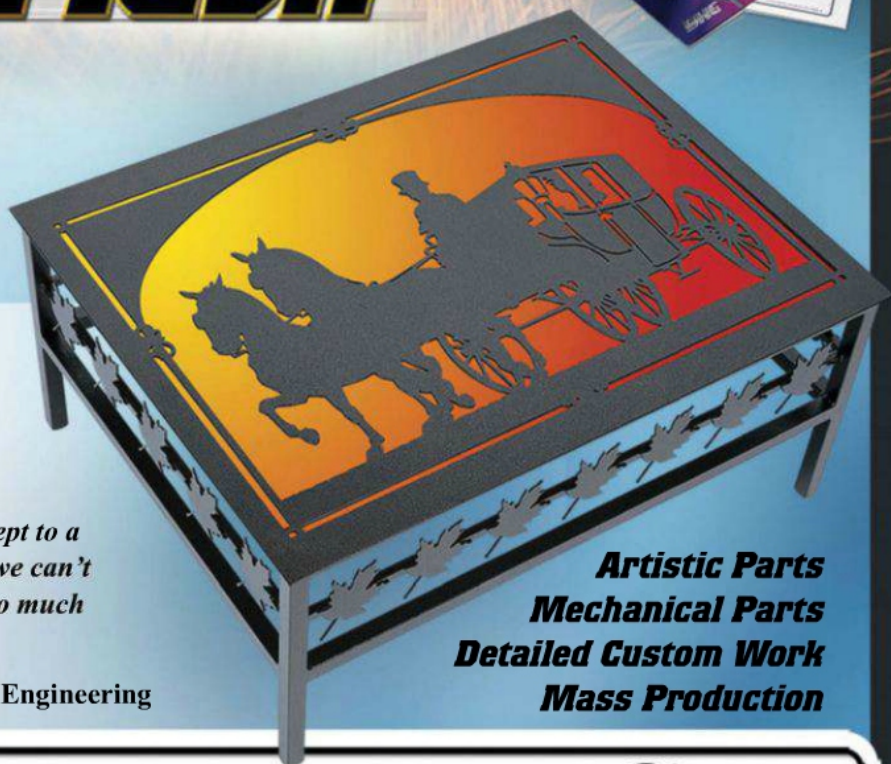


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## GLOSSARY

## PIPE SCHEDULE

In 1927, the American Engineering Standards Committee standardized the measurement of steel and iron pipe sizes and strengths. This led to the pipe schedule, a scale of 5 to 160. As the number grows, so does a pipe's wall thickness and ability to withstand internal pressure.

## THE BUILD



## 1 ASSEMBLE THE FOUR AIR INTAKES

Using  $\frac{1}{4}$ -inch threaded pipe and fittings (see Parts List, page 126), connect the close nipple to the 90-degree elbow and the elbow to the 24-inch-long pipe. Slip a U-bolt and mounting plate over the pipe, then attach the brass ball valve (positions shown above). Hand-tighten the parts (below). Then clamp the elbow in a vise, and secure the connections with a wrench on the valve's facets.



## 2 MAKE THE LID HANDLE

Hand-tighten a  $\frac{1}{2}$ -inch close nipple into the flange pipe fitting (above, center). Align the  $\frac{1}{2}$ -inch opening of the reducing elbow over the nipple, and turn the elbow onto it. Thread the 6-inch-long piece of  $\frac{1}{4}$ -inch pipe into the elbow, and tighten the connection with pliers. Slip the spring handle over the pipe, and thread the cap onto the pipe's end to hold the handle in place. The entire assembly will be bolted to the lid (left) in a later step.



## THE DELICIOUS CHEMISTRY OF SMOKING



Smoking takes 3 to 18 hours or more and occurs over indirect heat maxing out at 215 to 250 F. Tough cuts such as beef brisket and pork shoulder make the best barbecue because they contain a lot of collagen protein, which forms the fiber that surrounds the lean muscle. Over low heat collagen breaks down into gelatin, which is as tender as, well, Jell-O. In lab speak, the collagen converts into hydrogen and hydroxide. This process, which occurs most readily at 140 to 160 F, makes the meat moist. By contrast, when a tough cut is prepared at high heat (say, in a 450 F oven), the muscle fibers cook through before most of the collagen converts to gelatin. The result is a tougher, drier finished product.



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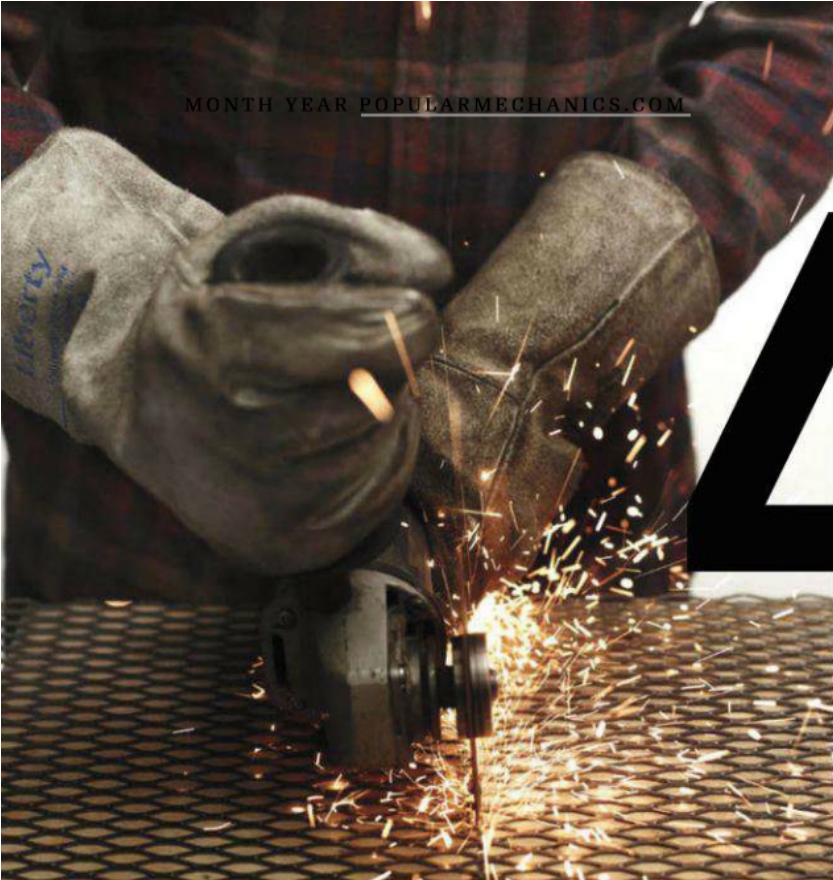
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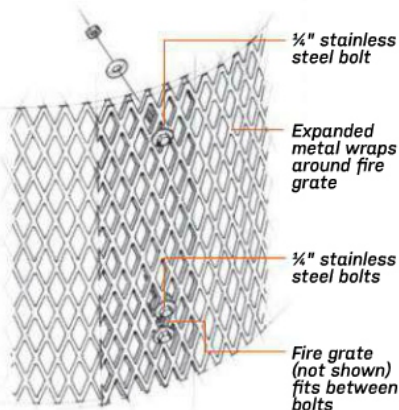


### 3 CONSTRUCT THE FIRE BASKET

Cut a 12 x 48-inch piece of expanded metal. The best way to do this is to mount the material to plywood with drywall screws, mark the dimensions with a Sharpie, and make your cuts with an angle grinder and cutoff wheel (above). Then mark the metal lengthwise 2½ inches from the bottom; align the charcoal grate on the mark, and roll the metal into a cylinder (below, left).

Where the metal overlaps, secure the cylinder using three ¼-inch stainless steel bolts, washers, and nuts. Use two bolts above the grate

and one below it, then space the remaining three bolts evenly around the basket's circumference. Form the handle out of stainless steel wire. Thread one end through the basket and twist the wire back on itself. Take the free end of the wire and do the same at the other side of the basket.



### 5 FIRE IT UP

Before you cook, load the fire basket with untreated charcoal, ignite it (use a coal chimney, not lighter fluid), and attach the lid. Fiddle with the intakes to make sure they're working, and let the fire burn hot to season the barrel and remove any impurities. After this dry run, stoke 6 to 12 pounds of charcoal in the fire basket, and add two or three fist-size chunks of flavoring

wood, such as cherry, hickory, oak, or maple. Place the basket in the smoker and the grill on its supports. Drop on the lid, and open the intakes. When the thermometer reads 350 degrees, close all but one valve to reduce the heat. Dial in a temperature from 215 to 250 degrees by adjusting the intakes. Load the grill with meat, and settle in for the long haul with some good company.

### 4 PREP THE BARREL

Use a 55-gallon food-grade drum with an open head. (Some drums are treated with epoxy to prevent rust, but meat smoked in such a barrel is toxic.) You can buy a new drum at an industrial-supply store for \$150 or less or a used one online for a mere \$20. Make sure that the drum and lid are untreated, and buff their insides with a scouring pad or fine sandpaper.

Mark an 11½-inch-diameter circle centered on the lid. Using a step bit, drill eight equally spaced ½-inch holes around the circle. Thread a ¼-inch pipe plug into each hole. Place the handle assembly on the lid. Mark the four bolt locations; drill them with the step bit. Bolt the handle to the lid.

Mark the hole locations for the air intakes, grill supports, and thermometer. Start each hole with a center punch, and bore the 1-inch intake holes with a step bit (above). Test each one by threading in a ¼-inch close nipple. Using a ¼-inch bit, drill the grill-support holes. The hole size you make for the thermometer depends on the model.

Add the air intakes by placing the close nipple into each hole and rotating the assembly. Align the intakes vertically, mark the U-bolt locations, drill on the marks, and slip a faceplate on either side of the barrel wall. Then tighten the nuts on the U-bolt. Secure the air intakes at the barrel's base by threading the pipe locknuts onto the close nipples. Create grill supports using the ¾-inch bolts, washers, and nuts. Attach the thermometer with its included nut.





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THE BOTTLE ROCKET

# Early Adopter

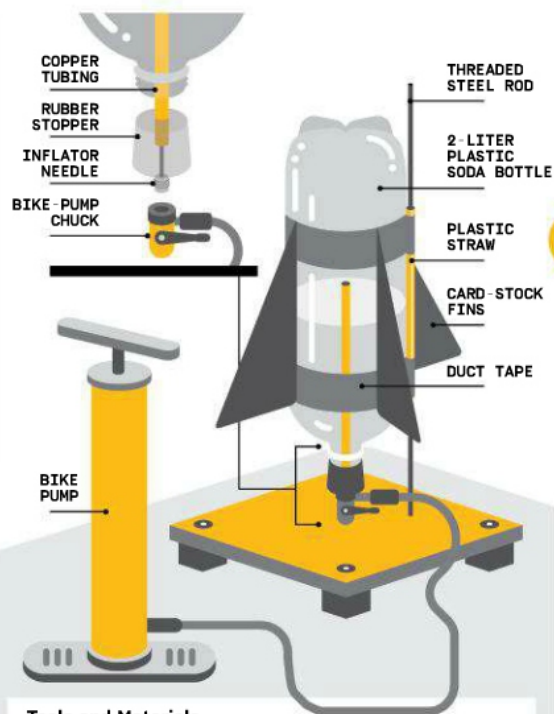
Luke Larsen, 7, clamps the bicycle-pump head to the stopper assembly, preparing for liftoff. Luke's twin sister and father built the rocket together.

NEVER HAS LEARNING NEWTON'S THIRD LAW OF MOTION\* BEEN SO MUCH FUN. MADE FROM A 2-LITER SODA BOTTLE AND PROPELLED BY A PLUME OF AIR AND WATER, THIS EASY-TO-BUILD ROCKET IS A FAMILY PROJECT THAT TURNS ANY AFTERNOON INTO A BLAST.

\*To every action, there is an equal and opposite reaction. Here, the rocket rises due to a focused, downward release of water and pressurized air.



## Building the Rocket



### Tools and Materials

- ▶ Electric drill with  $\frac{1}{16}$ -,  $\frac{5}{32}$ -, and  $\frac{1}{4}$ -inch bits
- ▶ One No. 4 size rubber stopper (1 inch long, 1-inch diameter at the fat end)
- ▶ One 8-inch length of  $\frac{3}{16}$ -inch (outside diameter) copper tubing
- ▶ Bicycle pump with inflation needle
- ▶ Heavy card stock
- ▶ One 2-liter plastic bottle
- ▶ Duct tape
- ▶ One drinking straw, minimum  $\frac{1}{4}$ -inch diameter
- ▶ Four 1-inch-square wood blocks
- ▶ One  $\frac{1}{4}$ -inch plywood board, 12 to 16 inches square
- ▶ One  $\frac{1}{4}$ -inch threaded steel rod, 18 inches long
- ▶ Four  $\frac{1}{4}$ -inch nuts
- ▶ Two washers,  $\frac{1}{4}$ -inch hole, 1-inch diameter



**The DIY family:**  
Michael Larsen  
with his twins,  
Ada and Luke, 7,  
and wife, Tracy  
Talbert.



**SAFETY FIRST:** Parental supervision strongly advised for build and launch.

### Make the stopper assembly

1. Drill a  $\frac{1}{16}$ -inch hole through the middle of the stopper.
2. Widen the hole by drilling the  $\frac{5}{32}$ -inch bit about  $\frac{1}{2}$  inch into the top (wider part) of the stopper.
3. Insert the copper tubing into the  $\frac{5}{32}$ -inch hole.
4. Push the inflation needle into the hole in the bottom of the stopper so that it feeds into the copper tube.

### Build the rocket

5. Make fins from card stock; attach to the bottle with duct tape.
6. Tape the 8-inch drinking straw to the side of the bottle (oriented from top to bottom).

### Build the launchpad

7. Attach square blocks to the corners of the launch platform (plywood), using quick-setting glue or  $\frac{1}{4}$ -inch wood screws.
8. Place the rocket in the center of the launch platform and mark the spot directly below the plastic straw.
9. Drill a  $\frac{1}{4}$ -inch hole through the mark; insert the steel rod into the hole, and fix in place with nuts and washers.

### Prepare the hydro-pump rocket for launch

10. Attach the bicycle pump to the inflation needle.
11. Fill bottle one-third full with water, below top of copper tube.
12. Push the stopper assembly firmly into bottle's mouth.
13. Invert the rocket, and slide the soda straw onto the rod.

### Launch the rocket

14. Pump air into the rocket. The amount of pressure required to fire the rocket will vary, depending on how clean the seal between the rubber stopper and the rocket is and how firmly the stopper is placed.
15. After several pumps, the pressure inside the rocket will be great enough to overcome the friction holding the stopper in place. Now comes the cool part, as the stopper releases from the rocket, and the rocket launches high into the air, shooting a trail of water behind it. *Zoom!*

# LEWIS & CLARK





“Give me a place to stand on and I’ll open any damn bottle.” Okay, maybe Archimedes never uttered those exact words. But his principle of leverage is the basis for the classic metal bottle opener—and also works with an odd variety of objects.



Put a one-handed stranglehold on the bottleneck, and use a [1] **DISPOSABLE PLASTIC LIGHTER** (a longtime fave) or a [2] **USB DRIVE** as a lever (and a knuckle as a fulcrum) to pop the top—and learn a refreshing lesson in applied physics.

An old standby (with a high spill factor): Place the bottle top in a door’s [3] **METAL STRIKE PLATE**, letting the crown catch on an inside edge; pull back on the bottle.

The squarish opening of a [4] **CAR SEATBELT LATCH** works surprisingly well. Never try this in a moving vehicle.

Position the fang-like teeth of a [5] **STAPLE REMOVER** under the crown and gently pull up, working your way around the cap until it’s loose enough to pull off. This “uncrimping” can also be used with a [6] **METAL NAIL FILE** or a [7] **KEY**.

WEEKEND



## 20 Ways to Open a Beer Bottle

BY WOOK KIM





Of course, your emergency beer-bottle-opening tool kit can include, you know, real tools: A **[8] FLAT-HEAD SCREWDRIVER** decrimps nicely, as do **[9] WIRE CUTTERS**, standard **[10] PLIERS**—or, better yet, those of the **[11] NEEDLE-NOSE** variety.

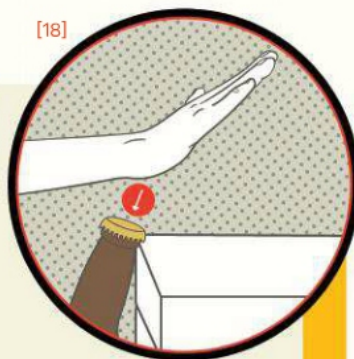
There is a brute-force alternative to decrimping for those lacking patience or manual dexterity. Clamp the bottle between your thighs and apply upward thrust to the cap's lip with the edge of a **[12] METAL RASP**, a **[13]**



**BUBBLE LEVEL**, or an electronic gadget, like an early **[14] IPOD NANO**. And if you're comfortable with a sturdy pair of **[15] SCISSORS** buzzing in your fly zone...

A **[16] RING** can open a bottle, too. (Not your wedding band, pal—soft metals like gold easily pit and bend.) Hook your finger over the top of the bottle, making sure the ring catches on the cap, and push up (or pull down) until it dislodges. This may hurt; but on the other hand: beer.

Swing the gate of a large



**[17] CARABINER** inside and use it to gain a purchase on the bottom of the crown; with the spine hooked over the cap, firmly pull up. **[18] COUNTERTOP** Hook the cap's lip on the edge of a hard countertop (not, God forbid, on an antique sideboard) and rap the cap with the heel of your palm. This also works on a **[19] SHARP-EDGED BOULDER**, or a **[20] BELT BUCKLE**, in which case, be careful where and how hard you strike.



**Please Don't!**

The above methods—PM-field-tested and -approved—represent the spectrum of ways to defeat those serrated-metal impediments to sudsy succor. But there are less-advisable techniques available for viewing online: Grip the bottle and carefully move the crown edge toward the spinning wheel of an upended bicycle, until a spoke catches and pops off the cap. Place the cap edge on the inside of your bottom row of molars, bite down, and pull the bottle up and away. Last and least advised: Hold the beer on the ground betwixt your boots, fire up a chain saw, and close in until a single chain tooth catches the bottom of the cap. Bring a change of underwear, and make sure your estate is in order.

## GLOSSARY

### HOGSHEAD

Kegs are for sissies. If you're looking to throw a bash for the ages, you should be talking hogsheads. Usually used to refer to a container or cask holding a large volume of any ole liquid, a hogshead is most often applied to measuring alcoholic beverages like wine, cider, and, um, beer. While a typical keg contains 15.5 gallons, a hogshead holds 54 gallons, perfect for those occasions when you're entertaining a small city.

# HIKING BOOT





## HomeClinic

BY  
ROY BERENDSOHN  
ILLUSTRATIONS BY BARQVIDEO

## Shelter From the Storm

We regularly experience severe storms where we live, and I want to stock up on emergency supplies. We don't have a basement. Can you give us some tips on storing these items in the garage?

It makes perfect sense to look at your garage as a command center if a natural or man-made disaster strikes. Clean up the clutter and you'll find a no-nonsense space with a concrete floor and great access for equipment. It's perfect for storing tools and supplies.

Your first job will be to build additional shelving and racks to organize your disaster-related materials—construction lumber and plywood work just fine for this purpose. Disasters are difficult to deal with, so you want ready access to your gear rather than having to disentangle what you need from lawn chairs, toys, and sports equipment. Shelving also protects tools and materials from the condensation that forms on many garage floors; this dampness can wreck stored items. If you live somewhere with high summer humidity, consider increasing air circulation by installing a low-speed fan or a

## THE GARAGE FORTRESS

If your region is at risk for hurricanes, earthquakes, or tornadoes, it's smart to beef up your garage, along with the house. The illustration at left shows some common vulnerabilities in any structure—and how to fix them. It's also very important to make sure your home conforms to local building codes.

### FRAMING

► There are many ways to fortify a garage, from bracing its roof trusses to adding metal brackets and straps that tie its parts together. You can even install brackets that better secure the garage to its foundation. A good basic guide is "Building for High Wind Resistance in Light-Frame Wood Construction." It's published by the Engineered Wood Association ([apawood.org](http://apawood.org)). Also visit manufacturer Simpson Strong-Tie's website to look at the connectors, the straps, the bolts, and the screws that can dramatically increase a wood structure's strength ([strongtie.com](http://strongtie.com)). "The most important thing is to create a continuous load path by connecting





## DISASTER TOOL CHECKLIST

YOU PROBABLY ALREADY OWN THIS STUFF, BUT IN CASE YOU DON'T, HERE'S A LIST OF GEAR TO KEEP READY.



### ■ ABC fire extinguisher

- ☐ American Red Cross Family First Aid Kit (item #321275, [redcrossstore.org](http://redcrossstore.org); \$25) or equivalent
- ☐ Bow rake
- ☐ Buckets
- ☐ Chain saw, spare chain, and chain saw fuel with preservative added



- ☐ Circular saw and spare blades (one rated for cutting nails)
- ☐ Claw hammer
- ☐ Cleaner and disinfectant
- Common nails and large self-tapping screws for wood and metal
- ☐ Cordless drill with bits for drilling and driving



- ☐ Duct tape
- ☐ Dust masks
- ☐ Exterior broom
- ☐ Flashlight
- ☐ Generator and heavy-duty extension cords, generator fuel with preservative added
- ☐ Hatchet
- ☐ Hose
- ☐ Knife or multitool
- Leaf rake
- ☐ Loppers



- ☐ Pry bar or demolition bar
- ☐ Rope
- ☐ Round-nose shovel
- ☐ Rubber boots with cleated treads
- ☐ Safety glasses
- ☐ Sledgehammer
- ☐ Square-nose shovel or scoop
- ☐ Tarps
- ☐ Wheelbarrow
- Work boots
- ☐ Work gloves

all parts of the structure from the roof to the foundation," Emory Montague, a structural engineer with Simpson Strong-Tie, says. This reduces the chances of a part blowing off, opening the building to wind forces.

### WINDOWS AND DOORS

► The best way to protect these openings is with plywood storm shutters cut to size ahead of time and stored on shelves in the garage. A valuable guide, "Against the

Wind: Protecting Your Home From Hurricane Damage," is available at FEMA's website ([fema.gov](http://fema.gov)).

### GARAGE DOOR

► Unless you have a garage door rated for high-wind resistance, you need to brace it with a vertical support and horizontal lumber. You can buy a kit consisting of hardware and mounting brackets, and a high-strength aluminum pole to install vertically behind the door ([securedoor.com](http://securedoor.com)).

power vent in the roof.

Storing fuel for chain saws, generators, and gas grills brings up an important safety issue. Never store propane in your house, not even in the garage. Find a sheltered place for it outside, such as behind a shed or a woodpile.

Similarly, keep as little gasoline as possible in the garage. If you have a shed, use that instead. Regardless of where you store your fuel, your safest bet is to use a self-venting metal safety can with a flashback arrestor. A 5-gallon can costs \$40 to \$90 depending on features. A plastic gas can that size typically costs about \$20, but spending the extra money for a metal can is worth it. The metal Type 1 can is far tougher, and that's a good thing during an emergency. The last thing you need is to create a disaster of your own with a fuel spill or fire.

Finally, never run a generator in a garage. Even with the door wide open, a generator produces enough carbon monoxide to kill you or make you very sick. Set up the machine well away from the house and



The Atlantic hurricane season begins June 1, and the next day **POPULAR MECHANICS** sets up shop at Houston's Reliant Center for its third **Home Safety Prep Show**. We'll be joined by guest speakers Colby Donaldson, Mykel Hawke, and *Cool Tools*' host Chris Grundy. We'll then be in New Orleans on June 23. Visit [popularmechanicshomesafety.com](http://popularmechanicshomesafety.com).

# GOODYEAR

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connect it to electrical loads with heavy-duty extension cords or a transfer switch wired into the home's service panel. Whatever you do, don't make a double-end extension cord with one end connected to the generator and the other plugged into a wall outlet. Known as backfeeding, this sends electricity to every other outlet on the same branch circuit. It's dangerous. If someone forgets to switch off the house's main breaker, the setup can send generated electricity out of the house and onto the grid, endangering utility workers, firefighters, and your neighbors working to clear storm damage.

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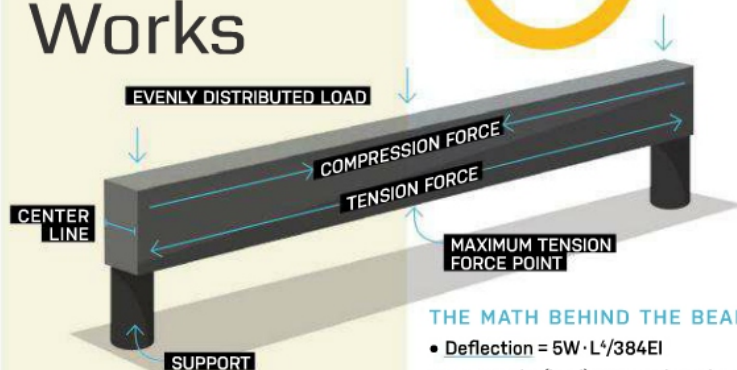
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## How a Beam Works



### THE MATH BEHIND THE BEAM

- Deflection =  $5W \cdot L^4 / 384EI$
- $W$  = weight (load) per unit length in psi
- $L$  = span length
- $E$  = modulus of elasticity; a figure for stiffness that varies by material. Engineers get the figures from published tables. Wood's  $E$  can be as high as 1.9 million psi; steel's  $E$ , 30 million psi.
- $I$  = moment of inertia (MOI). This describes a beam's resistance to bending as a function of its cross section's shape.
- Different shapes have different MOI formulas. For a rectangular beam,  $MOI = BH^3/12$  where  $B$  is the width of the base and  $H$  is the height. Notice that the height is cubed, reflecting the fact that any increase in height adds powerfully to bending resistance.

● **WHAT IT DOES:** A wood beam in a house can bear massive loads—the weight of entire floors or the roof. (These loads are then transferred to structural elements such as posts and ultimately to the ground.)

● **THE SCIENCE:** Beams look simple, but they experience complex physics. The load from above bends the beam downward; the wood fibers on its top half are forced against one another in **compression**. At the beam's bottom half, the wood fibers are stretched apart in **tension**.

● **BEFORE YOU DRILL:** The boundary where compression and tension forces equal each other is called the **neutral axis**. And that's the ideal region to choose if you need to bore a hole and route cables or pipes. Close to the top or bottom edge of the beam, the bending forces are greatest. Near the neutral axis, bending forces are mild. (Local building codes provide specific measurements.)

● **CRITICAL MATH:** If tension and compression on a beam are great enough, bad things happen. It's crushed where it bears on its supports, it cracks, it bends catastrophically downward, or it buckles sideways.

But engineers can predict a beam's performance with a great deal of precision using the formulas above, which put a number on downward deflection (or bending).



## Plastered

All the walls and ceilings in my house, which dates to 1945, are covered with lath and plaster. Sometimes the upstairs walls develop large blisters and then the plaster crumbles and turns to dust. I repair one area, but then the problem returns. What can I do?

Plaster doesn't mysteriously blister on its own. You've got a moisture problem. The plaster absorbs water like a sponge, expands, and then crumbles when it dries out. I suspect you have an exterior leak. Water could be coming right through the roof or through a gap where the roof meets a chimney. Roofs also can leak where one plane meets another at an intersection known as a valley. In fact, there are innumerable potential sources of exterior leaks in an old house—and the only way you'll find them is to get up on a ladder—and maybe even onto the roof—to do an inspection. If that makes you uneasy, hire a roofer.

Now, suppose your inspection doesn't find anything. It's also possible that you've got a leaking water pipe or that condensation is forming on a cold-water pipe and then dripping onto the plaster. You might be able to check for this by taking a bright light with you into the attic and having a look around (be careful where you step in order not to damage electrical boxes or wiring).

Solve the moisture problem, solve the plaster problem. **PopMech**

?

**GOT A HOME-  
MAINTENANCE OR  
REPAIR PROBLEM?  
ASK ROY ABOUT IT.**

Send your questions to [pmhomeclinic@hearst.com](mailto:pmhomeclinic@hearst.com) or to Home Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.

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#### WASTED POWER

The average U.S. household owns 25 consumer electronics products, many with chargers or "always-on" features such as remote control that draw a constant trickle of electricity.

## Science



BY EMILY GERTZ

## POWER BALLAD

When I started learning DIY electronics, using Arduino was the obvious choice. This palm-size, single-board microcontroller, which can be easily swapped between projects, is designed for programming novices. Yet it has more on-board processing power than the navigation computers used by Apollo astronauts—and at about \$30 a pop.

These qualities make Arduino the go-to component for building DIY environmental-monitoring devices, such as the electromagnetic interference (EMI) detector shown here. Because it converts invisible electric vibrations into audible sound, it's handy for identifying sources of standby power: the energy that flows constantly through electronics, even when they're supposedly off. Cut the power to those electronics between uses and you'll reduce your electric bill and your carbon footprint.

When you're ready to build something new, take this gadget apart and reuse the Arduino in your next project. Try that with a watt meter from the hardware store. **PopMech**

**ENERGY CONVERTER**  
When the detector's antenna picks up electromagnetic waves, it sends the voltage to the Arduino, which converts the info to a tone emitted by a speaker.

**AUDIBLE SOUND**  
The tone will sound lower near a charging cellphone—which draws 3.7 watts of electricity on average—than near a DVR, which draws nearly 40 watts on average even when turned off.

Arduino microcontroller  
8-ohm speaker

#### PROJECT: ELECTROMAGNETIC INTERFERENCE DETECTOR

**Rough Cost:** \$42

**Time Commitment:**  
About 1 hour

**Skill Level:** Easy

**Why Make It:** This is a DIY electronics skill-builder with a practical application—reducing standby power, which adds as much as 10 percent to U.S. residential electric bills.

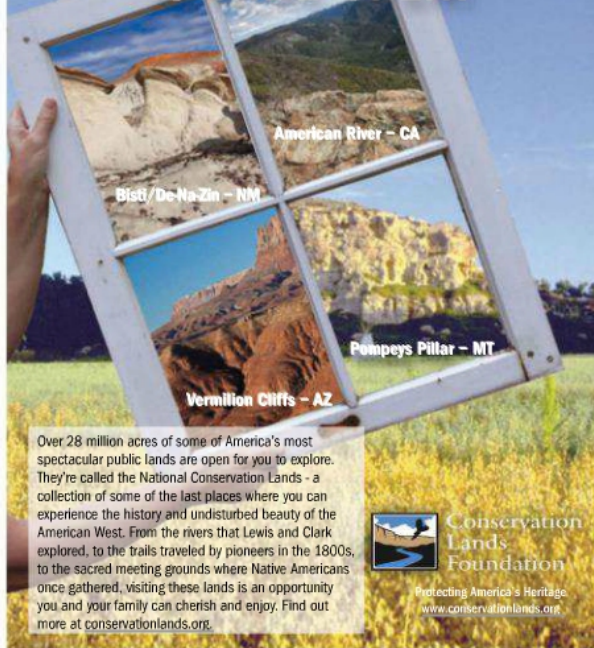
**Instructions:** [popularmechanics.com/emidetector](http://popularmechanics.com/emidetector)

W

WEEKEND



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BY BEN WOJDYLA

## 20/20 HINDSIGHT

HAVE AN OLDER CAR AND WANT A BACKUP CAMERA? IT'S A SURPRISINGLY CHEAP AND EASY UPGRADE.

**B**ackup cameras are a nearly universal option on new cars and will likely be mandated for all cars by 2014. And for good reason: The compact cameras provide a view of what's behind the car, reducing the chance of backing over a bicycle or, worse, the kid riding it. Plus, the device greatly eases parallel parking.

But the average age of a vehicle on the road is 10.8 years (up from 8.4 in 1995), which means the vast majority of cars and trucks don't have this feature. If you plan to keep your older car but still want the peace of mind that comes with a backup camera, it's not too difficult to install one yourself.

Aftermarket manufacturers now produce a wide array of DIY rearview camera kits. The cost varies, based on the size and resolution of the digital screen. A hundred bucks—the price of our wireless kit from Peak Automotive—buys a good balance of quality and easy installation. We installed it in a 2003 Honda Civic coupe. The hard part was opening the plastic clamshell package.

This backup mirror from Peak Automotive hides a 640 x 480-pixel screen behind a one-way mirror.

WEEKEND

ILLUSTRATION BY CALUM ALEXANDER WATT





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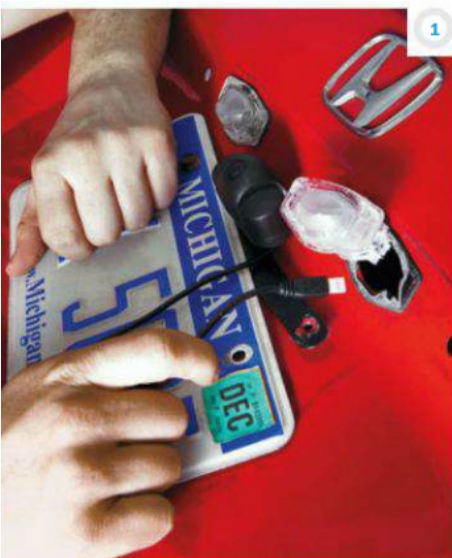
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## INSTALLATION

Our camera-kit installation didn't require a deep dive into the toolbox. All that was necessary was a wrench to remove the license plate and some simple wiring tools. The kit has three parts: the camera, which mounts to the rear license-plate bracket; a transmitter that sends video wirelessly; and a rearview mirror with an integrated screen. A signal wire runs from the camera through the trunk or cargo area and plugs into a small control-box transmitter. You may need to get creative passing the wire to the interior. We snaked it behind a license-plate light [1], but it might be necessary to drill a small hole in the trunk or hatch and use the included grommet to protect the wire from the hole's edge. The transmitter is powered by splicing into the wiring for the backup light [2], which is electrified only when the car is shifted into reverse. Mounting the camera took us all of 15 minutes, and we got a clean,



nearly undetectable install.

Since video is transmitted wirelessly, we didn't have to run a signal wire through the cabin to the dashboard. Inside the mirror housing are the video signal receiver, a 640 x 480-pixel monitor hidden behind a one-way mirror, and a few control buttons to adjust the picture. Installing the mirror is even easier than hooking up the camera. All we had to do was mount the new mirror over the old one [3]. A spring-loaded clamp grabs on to the top and the

The amount of work for installing a backup camera varies. This one's simple; other kits may require a run of wire through the cabin.



## WIRE IT RIGHT

### CRIMPER

The most indispensable wiring tool, it cuts wire, strips insulation, and crimps connectors. Red, blue, and yellow dots coordinate with colored connectors. Strip by matching your wire's gauge to the size marked on the cutter.



### WIRE

Pick the right American wire gauge (AWG) to carry the current for your device. Too small and the wire burns; too big and you're wasting money. For long runs, bump up the wire gauge by one size to offset increased resistance. In cars, use stranded wire—it resists breakage from vibration.



### CONNECTORS

Ring, spade, or blade? A permanent install on a bolt: [ring](#).

Awkward location but rarely removed: [spade](#). Connecting one wire to another: [blade](#).

Insulation is color-coded for wire size:

Red: 16 to 22 gauge

Blue: 14 to 16 gauge

Yellow: 10 to 12 gauge



## GLOSSARY

### ONE-WAY MIRROR

Made famous by TV cop-show interrogation rooms, these tricky mirrors let light through on one side and reflect it on the other. The reflective effect is negated when light passes through from behind the mirrored side, as is the case with our backup-camera display.





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## DIY AUTO / CAR CLINIC



bottom of the factory mirror, and Velcro strips wrap around it to keep the kit mirror in place.

To power the new mirror, there are several options. Tuck the power cord that plugs into the top of the mirror into the front of the headliner. Then route the wire down the driver-side A-pillar, where you can hide it behind the trim and run it into the dash. Our A-pillar trim came off by hand, but yours might require a bit of work with a screwdriver or a trim-removal tool to get it free. From here you can either plug it into the cigarette lighter or permanently install it into a keyed-on circuit. We chose the latter and tied into the fuse box with a splice to the radio circuit, which comes on with the ignition. Use a test light and your ignition key to find a circuit that makes sense for your car. The whole installation should take 30 to 45 minutes if you're obsessive about it, 10 minutes if you aren't.

### RESULTS

So how well does it work? Surprisingly well. We were impressed by how quickly the monitor and

the camera start up when the car is turned on and shifted into reverse, especially for a \$100 piece of tech. The image is very clear (even at a 3-inch screen size), and the camera performs well in both high- and low-light situations. There is, however, an idiosyncrasy we noticed while cruising through town. The mirror's receiver is always on while driving and constantly searches for the video signal from the camera. When it finds one, the screen is immediately turned on and displays the signal, regardless of where it's coming from. This is a bit strange when you drive through pockets of interference. On one or two occasions during a 40-mile drive the screen turned on and displayed a static pattern similar to what you'd get on a television tuned to channels with no signal. It didn't happen often, but in a big city with lots of electromagnetic interference, it could get distracting. The fix is relatively easy: Turn the mirror off when you're cruising. We've decided this quirky behavior isn't a big deal for such an easy and useful upgrade.

## Don't Be an Idiot

### OVERTIGHTENING BOLTS



It's tempting. You're putting something together and really don't want it to come apart—what harm could it be to put a bit more elbow grease into tightening those bolts? Use the old German torque spec: gut und tight. Unfortunately, overtightening can lead to problems. First and foremost, you can damage the bolt by

twisting the head off or stripping the bolt or hole threads. All bad news. Too much grunt can also cause premature failure in gaskets and bearings and cause the stuff you're putting together to just plain not work. Do yourself a favor: Get a torque wrench, some specs, and do it right. It'll save a lot of pain down the road.

**PM ON YOUTUBE** The Car and Driver Channel premieres on May 1. For a chance to appear on the *Saturday Mechanic* show, hosted by PM's associate auto editor Ben Wojdyla, submit your car-related questions to [popularmechanics.com/cdchannel](http://popularmechanics.com/cdchannel).



WEEKEND

ILLUSTRATION BY PATSWERK



## Car Clinic

### DIY AUTO

BY  
BEN WOJCYLA

PHOTOGRAPH BY  
BRIAN KELLY

Gauge clusters come to the factory prebuilt; plastic connectors (quick disconnects) supply power and signal to them. After many miles, these parts can get fussy.

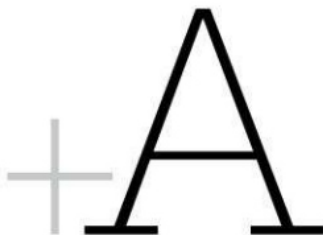


## Party Lights

I have a '96 Nissan Pathfinder and my gauge cluster has started to go on the fritz. It'll randomly cut in and out while I'm driving, with the gauges going from proper operation to flat needles and no light. I've checked all the fuses, but everything looks okay. Have any ideas?

That's not a defect; it's a feature—interior strobe lighting! Seriously, though, if the fuses are fine, there are two paths to investigate and neither is much fun. This kind of thing can usually be narrowed down to a corroded ground wire or a bad connection between the gauge cluster and the main wiring harness. Clusters generally consist of one large circuit board with stepper motors to turn the dials, light bulbs or LEDs to brighten the instruments, and microcontrollers to make it all work. Everything is driven through inbound wires attached via plastic connectors.

Your Pathfinder has three of these connectors on the back of the cluster, and one of them may have gone finicky. If you're going to fix it yourself, you need to be brave: The driver-side dash will have to come apart. Take your time and figure out how the unit was assembled; everything in a dash is built from the inside out, which means the last part on will be the first off. Start with the trim and look for the bolts and screws that hold the structure together, slowly removing each piece while keeping track of all those nuts and bolts and snapping pictures as you go. Always consult a vehicle service manual, too. Eventually you'll be able to pull the cluster away from the instrument panel and view its hindquarters. Inspect the connections for signs of corrosion, which you can clean with solvent, and for breakage. If you don't see anything wrong, you're in for an arduous journey, tracing all the wires through the skeleton of the dashboard. What you're looking for is a wire routed against the metal support structure. Over time the vibrations



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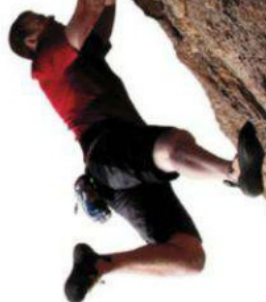
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from the road may have worn a hole in the insulation of one such wire. As you drive, the exposed copper is grounding to the chassis, making the gauges do their little on/off dance. If that's not the case, you're looking at having to replace the cluster. This is not difficult, but it's usually quite expensive because the odometer has to be synced by a dealer.

## Coolant Sucker

**Can you use a wet-dry vac to evacuate antifreeze from a radiator with no drain plug?**

No. It's a clever thought, but sadly it's not realistic or good for the engine. First, you don't want toxic antifreeze in your wet-dry vac; when it dries it leaves a sticky residue that won't be fun to have in your vacuum. Second, because of the way



3

QUICK FIX

## Replacing Hatchback Struts

### 1 Work Safe(ish)

Prop open the hatch with a stick or pipe. You know, the one that's held it up for months.

### 2 Out With the Old

Use pliers or a screwdriver to extract the retaining clips on both ends of the spring piston. With the screwdriver, pry out the pins on both ends and remove the piston. Swap any old hardware onto the new piston, and grease the pins for quiet operation.

### 3 In With the New

Place one end of the piston in the bottom mount and insert one of the pins you saved. Raise the other end into position, and push the upper retaining pin in. Then install both retaining clips. Repeat on the opposite side if necessary. Toss the old stick; you don't need it anymore.

WEEKEND

PHOTOGRAPHS BY NICK FERRARI



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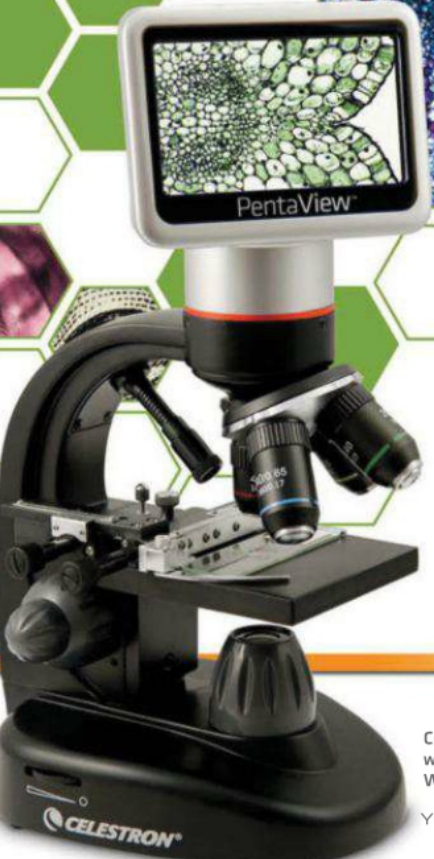
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radiators are made, you'll never remove all the coolant or the gross sediment that builds up inside. For these reasons, it's best to let gravity do the work and empty the coolant from the bottom. If your car doesn't have a drain plug, pick out the lowest hose in the coolant system and loosen the clamp holding it in place. Before you pull the hose off, position a large bucket beneath

the radiator to collect the old stuff. Now disconnect the hose and direct the flow of coolant into the bucket. It's a good idea to have a second bucket handy—you never know how much fluid is going to come out. You may also need to remove a plug in the engine block to get even more out; that varies from car to car. To do a complete flush, reconnect the lower radiator hose and fill the system with clean distilled water. Run the engine for a few minutes until the cooling fan cycles on and off a couple of times. This prompts the thermostat to open and coaxes the coolant in the heater core to cycle through the rest of the system. Shut off the engine, wait for it to cool, and drain the fluid out as you did before. Be sure to properly dispose of the used coolant—remember, this stuff is deadly for pets, children, and

other living things. Most parts stores and landfills will accept it for recycling.

Now you can replace the coolant. Check the owner's manual to make sure you use the correct type. There are variations in color—green and orange are two options—and chemistry, and coolants should never be mixed. The incorrect option can react very badly with the gaskets and the surfaces in your engine. Since there's bound to be some residual fluid in the cooling system—it's nearly impossible to drain the engine block—find out the coolant capacity, but realize you'll have to fill as needed. Add coolant and water alternately—a 50/50 mix is usually recommended—until the level reaches the top of the overflow tank or radiator. When it's filled, start the engine and let it run. The water pump will pull the coolant through the system. Add water and coolant as necessary to keep it filled. Once again, you'll want to keep the engine running long enough to open the thermostat so the heater core fills up. One final note: I typically use distilled water rather than the stuff from the tap. The minerals and purification chemicals in faucet water may lead to corrosion and scaly buildup in the engine. Premixed coolant is also available. It costs more, but it is convenient. **PopMech**

10

WEEKEND

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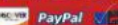
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## GUTS, GLORY AND MEGAPIXELS

CONTINUED FROM PAGE 77

To see how completely the company dominates the rugged camera market and to understand its influence on action sports, search the term "GoPro" on YouTube. The result: clip after clip of awe-inspiring F/A-18 Hornet rides, avalanche cliff jumps, supercross races—all shot by users. (A search for "Nikon" produces page after page of product reviews.) This is no accident. GoPro employs a social media team charged with nurturing its customer base via daily giveaways and prominent exposure on [GoPro.com](http://GoPro.com), Facebook, and YouTube. What the company seems to understand better than its competitors is that a customer showing off what he did with his Hero on YouTube is far more valuable than a clip of him talking about his camera.

Today Woodman and company cater to their fan base with an ever-increasing number of mounts for snow, skate, bike, moto, and virtually any sport in their adrenaline-fueled world. That's consistent with how Woodman sees GoPro, as the maker of exceedingly rugged building blocks that let customers invent how they shoot, not just what they shoot. Woodman—who wore head-mounted Heroes when his kids were born—imagines a surgeon using a custom capture device in the O.R. that riffs off something a kite surfer devised.

If it all sounds a bit far-fetched, consider that this vision is already playing out. The first step was the 3D Hero System—which uses the built-in Hero Port to combine two 2D cameras into a single 3D device. The new Wi-Fi BacPac allows a smartphone to monitor, control, and stream video from up to 50 cameras. It's all part of Woodman's passionate "go big or go home" mindset, which is at the core of the GoPro DNA. It's what inspires the brand's loyal users to shoot and share their most intense moments, and it may be the secret ingredient for the company to outmaneuver Sony, Canon, and Apple in the not-too-distant future. "You have to strive to be a top player or you shouldn't bother doing this in the first place," Woodman says. "If you're just muddling along, you're going to get smoked." **PopMech**

## TOTAL RECALL

CONTINUED FROM PAGE 91

consumers to further ignore product-defect notices. "The problem is that we end up making the judgment, when that should be left to consumers," the NHTSA official says. "If they think the risk is too minor, they won't take advantage of the remedy."

If scare tactics worked—if they actually made people comply with recalls—then perhaps a little hyperbolic horror would be a good thing. Unfortunately, says William K. Hallman, a psychologist and director of the Rutgers University Food Policy Institute, fear turns out to be a lousy motivator. "Scaring the crap out of people doesn't work," says Hallman, who is working with the FDA to help improve recall communications. "When people are that terrified, the outcome is usually no action at all."

## AS I READ THROUGH THE ACCOUNTS

of various recalls, I found myself wondering: Regardless of whether the issue is a foot on the wrong pedal or a Roman candle aimed in the wrong direction, how much responsibility do manufacturers bear for operator error? In the case of Mark Saylor, someone was clearly at fault: the dealer who installed the floor mats in his loaner vehicle. But what about when consumers purchased floor mats that weren't made by Toyota? The company's corrective action, which included a pedal redesign to make mat entrapment less likely, was the right thing to do; a shopper should be able to reasonably expect that a product will be safe under standard usage. That said, many cases I looked at seemed to revolve around good people making honest mistakes—bad mistakes, sometimes—and being unable to recognize or admit to the fact.

One company that attempted to both do the right thing—fix a problem that wasn't necessarily a defect—and point out that customers had a responsibility to use its product correctly is Maclaren, one of the world's largest makers of baby strollers. In November 2009, the U.S. subsidiary of the British firm recalled 1 million umbrella-type folding baby carriers. Twelve children had suffered injuries, including partial amputations, when their fingertips got caught in the product's folding mechanism. Those injuries never

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occurred when children were actually in the strollers—only when they became entangled as parents were folding the equipment. The problem also wasn't unique to Maclaren strollers.

Despite clear instructions on proper usage, Maclaren agreed to a recall. It was preparing to announce the effort when the process suddenly went awry, according to company CEO Farzad Rastegar, writing in the January 2011 *Harvard Business Review*. Maclaren had planned to issue a press release announcing the recall on Nov. 10, 2009, but one day earlier, word of the recall leaked to the *New York Daily News*, setting off a media frenzy. "For several months," Rastegar wrote, "we had worked with the CPSC on a plan to make owners more aware of the danger and to provide protective hinge covers . . . But the news story provided none of this context. Nor did it explain that practically all strollers on the market have similar hinges."

Within 24 hours TV crews showed up at the company's Connecticut headquarters and hundreds of mommy blogs issued frantic warnings. Panic ensued. A Brooklyn mother told *The New York Times* that the two biggest threats her children faced were "swine flu and Maclaren strollers." The company's website and email crashed—and even that was portrayed as an example of Maclaren's ineptness.

"We had hoped that the recall would build awareness about the wider risks of operating a stroller, not just about hinges," Rastegar wrote. "Instead, we would have to start defending our brand."

In the end Maclaren distributed more than 300,000 hinge covers. Even so, by the end of 2011, 149 additional injury reports had been filed, indicating typically low recall compliance. Even as it reissued notices, Maclaren insisted the process was flawed. Its website pointed visitors toward a document calling for all stroller manufacturers to offer hinge covers. (Several brands with similar designs have been recalled, but I was able to find five folding strollers with unprotected hinges in less than an hour of shopping.)

CPSC's Filip says the piecemeal approach to umbrella-stroller recalls could change; the CPSC could issue a category-wide product-defect order, as it did for drop-side cribs in 2011. But in order to do that, the agency would need "to make a strong case for

intrinsic danger," he says. So far, such a case hasn't emerged.

Just after Christmas 2011, Maclaren USA filed for bankruptcy. Among the listed liabilities were "unknown" claims (meaning the amounts were undetermined) by seven families and law firms suing the company, along with the CPSC, for ongoing expenses related to the stroller recall.

### PRODUCTS NEED TO BE USER-

friendly in the real world, where people are in a rush, where crevices get jammed with gunk and goo, where—in the case of car seats—Mom's vehicle might have deep buckets and Dad's truck might have a bench. We're a one-car family, but even so, I was surprised at how difficult it was to install our car seat (it didn't help that I was doing it for the first time while my wife was in labor—don't ask). Statistics show that as many as 80 percent of existing car seats—depending on the seat type, the age of the child, and the vehicle—are improperly installed or misused. It's been that way for decades despite efforts to teach parents the correct process. There are more than 25,000 certified car-seat-installation technicians in the U.S., most of whom offer their services for free through local hospitals and police and fire departments.

Maybe the expectation of ease is unreasonable. A car seat is a complex product that has a very critical function. As much as I wish that my car seat would simply click in and always be secure, I know better: I've got to learn how it works, use it correctly, and maintain it.

By the end of this year, Dorel will submit a report to the NHTSA outlining the results of the Vantage recall. Most likely, compliance will be low, and most likely, it will be difficult to determine if any injuries have occurred because of the recalled product or if any have been prevented by the recall. What's certain is that there will be more recalls. Parents and manufacturers will continue to make mistakes—something I became personally aware of when, using Urban Apps' Recalls for iPhone, I made a second pass through my house.

One of our son's earliest favorites was a bright yellow baby chair called a Bumby. I discovered it had been recalled in 2007 after reports that children pitched them-



selves out of it. Though there were some design flaws, the bigger issue seemed to be misuse: Serious injuries occurred when the product was placed on a table or counter, resulting in a fall from height.

I was well aware of this problem; I'd almost let it happen myself. We were having dinner, and I'd placed the Bumbo in the center of our dining room table. Our son wriggled forward, and suddenly he was out of the chair. He didn't fall off the table, but it was close—and I felt terrible about the bump on his head.

With the Bumbo I broke two major rules when it comes to product safety. First, I didn't follow the instructions. That was because—here's the second broken rule—I didn't have instructions. We bought the product used, as more and more parents are doing these days; reselling a recalled product is illegal, though such goods can be readily found at garage sales and on auctions sites like eBay. But mostly I didn't use common sense.

Personal responsibility isn't the sole answer. It needs to be backed up with an approach to defects that's evidence-based, and with communications that get genuinely bad products off the market. One such model can be found in membership clubs. Costco's Wilson says that traditional recall notices have been so ineffective that his company created its own system, maintaining a database of everything a customer buys. When a recall is announced, the company calls everyone who has ever purchased the product, then follows up with a letter. It also has an internal recall process that moves far more quickly than a government agency's, issuing notices for products it believes are unsafe based on negative customer feedback. Wilson says that Costco's effectiveness rate for reaching consumers is more than 90 percent.

Could that Costco model be applied to

consumers who don't buy at membership-based stores? Widespread use of debit cards, transactions that automatically register serial numbers for inventory control, and the fact that most major retailers now have loyalty programs that track purchases indicate the data may be available. (CPSC's Filip says such a program is not within the agency's current mandate.)

Several companies are developing search-engine-like technology that trolls federal recall sites. WeMakeItSafer, for example, reformats and consolidates the information into useful data, then notifies registered users directly when there is a relevant recall, or works with retailers and manufacturers, who can direct the recall toward a specific database of customers. That way, consumers will receive information only about products they own. "The answer isn't telling the world there's a recall in the hope of reaching the few people that own a product," CEO Jennifer Toney says. "It is about using technology to home in on just the people who need to know they have issues with something they own and need to get it fixed."

I want—for myself and my family—to be protected from truly defective products. But I also want to see a system that is honest about identifying those products, that assesses risk properly, that advocates responsibility as much as—or more than—it assigns blame. I want to know that decisions are being made carefully enough that I'll be likely to hear about them—and likely to care about them. I'd be delighted if the government did that; I'd also be delighted if that was something that could happen via new technology or through my favorite retailer or anyone else who could figure it out. I'd even be happy to get the message from Elmo. I just want the message to mean something. **PopMech**

**POPULAR MECHANICS** (ISSN 0032-4558) is published monthly, 12 times a year, by Hearst Communications, Inc., 300 West 57th Street, New York, NY 10019 U.S.A. Frank A. Bennack, Jr., Chief Executive Officer and Vice Chairman of the Board; George R. Hearst, Jr., Chairman; Catherine A. Bestron, Secretary; Ronald J. Doerfler, Senior Vice President and Treasurer; Steven R. Swartz, Executive Vice President and Chief Operating Officer. Hearst Magazines Division: David Carey, President; John P. Loughlin, Executive Vice President and General Manager; John A. Rohan, Jr., Senior Vice President, Finance.  
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CANADA BN NBR 10231 0943 RT. POSTMASTER: Send address changes to **POPULAR MECHANICS**, P.O. Box 6000, Harlan, IA 51593. Printed in U.S.A.

**EDITORIAL AND ADVERTISING OFFICES:**  
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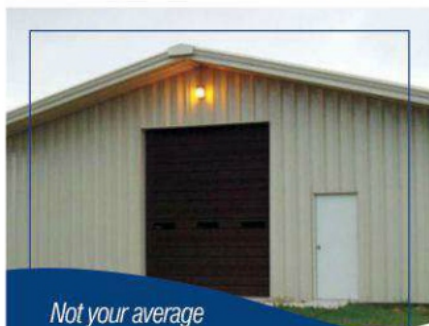
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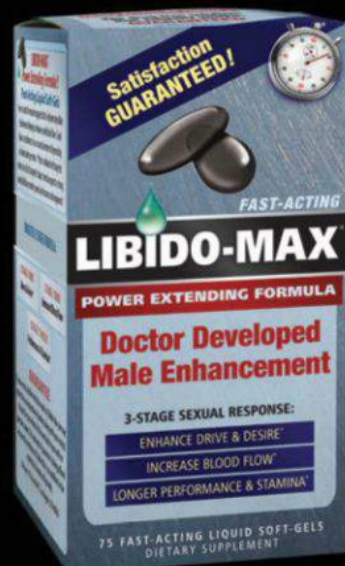
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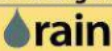




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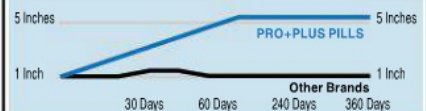
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## A BRIEF HISTORY OF THE...

# Surfboard

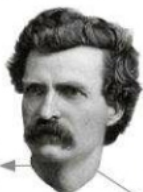
These days anyone can grab a surfboard and hang 10. Some even ride them down waves as tall as 10-story buildings (dude!). From its humble wooden beginnings, we explore the surfboard's past—and look to its future.

BY ERIN MCCARTHY

**CIRCA 500:** Surfboards are to sixth-century Polynesians what Ferraris or giant flat-screen TVs are to Americans today—the ultimate status symbol. And size matters: Tribal chiefs and nobles ride boards as long as 25 feet, while commoners catch waves on 7-footers.

**1778:** During a stop in Hawaii, the crewmen of Capt. James Cook's HMS *Discovery* become the first recorded Europeans to witness surfing.

"I GOT THE BOARD PLACED RIGHT, AND AT THE RIGHT MOMENT, TOO; BUT MISSED THE CONNECTION MYSELF. THE BOARD STRUCK THE SHORE IN THREE-QUARTERS OF A SECOND... AND I STRUCK THE BOTTOM ABOUT THE SAME TIME, WITH A COUPLE OF BARRELS OF WATER IN ME. NONE BUT NATIVES EVER MASTER THE ART OF SURF-BATHING THOROUGHLY." — MARK TWAIN, *ROUGHING IT*, 1872



**1907:** Surfing makes its mainland debut at an event for, weirdly, the railroad. Hawaiian George Freeth—who reinvigorated surfing by cutting his 16-foot redwood board to a more nimble 8 feet—demonstrates his skills in this publicity stunt for the Redondo–Los Angeles Railway.

**1926:** Tom Blake—who was born in Wisconsin and later moved to Hawaii—drills holes in his 15-foot-long redwood board to reduce its weight, then encases it in two other pieces of wood. His friends scoff at the "Cigar Board," but in 1930 a version of his super-fast board becomes the first ever to be mass-produced. Seven years later, he publishes plans for a DIY board in PM.

**1932:** The introduction of balsa decreases surfing board weights from 100 to 30 pounds—which makes impressing beach bunnies by hoisting a board overhead much easier.

**1934:** Hawaiian surfers taper the tail end of their boards; the new, more hydrodynamic design allows them to maneuver into the curl of the wave and ride in the pipe.

**1935:** Blake creates the fixed-tail fin, which increases maneuverability and stability. (Twin fins hit surfboards in the late '60s, triple fins in the early '80s.)

**1940S TO '50S:** Fiberglass, invented in the '30s, is used on surfboards after World War II. In the '50s, Hawaii's George Downing creates "gun" longboards: Shaved from polyurethane and finished in fiberglass, the narrow, lightweight boards are ideal for big-wave riding.



"MY SURFER KNOTS ARE RISING / AND MY BOARD IS LOSING WAX / BUT THAT WON'T STOP ME, BABY / 'CAUSE YOU KNOW I'M COMING BACK... SURFIN' IS THE ONLY LIFE / THE ONLY WAY FOR ME."  
— BEACH BOYS, "SURFIN'," 1961

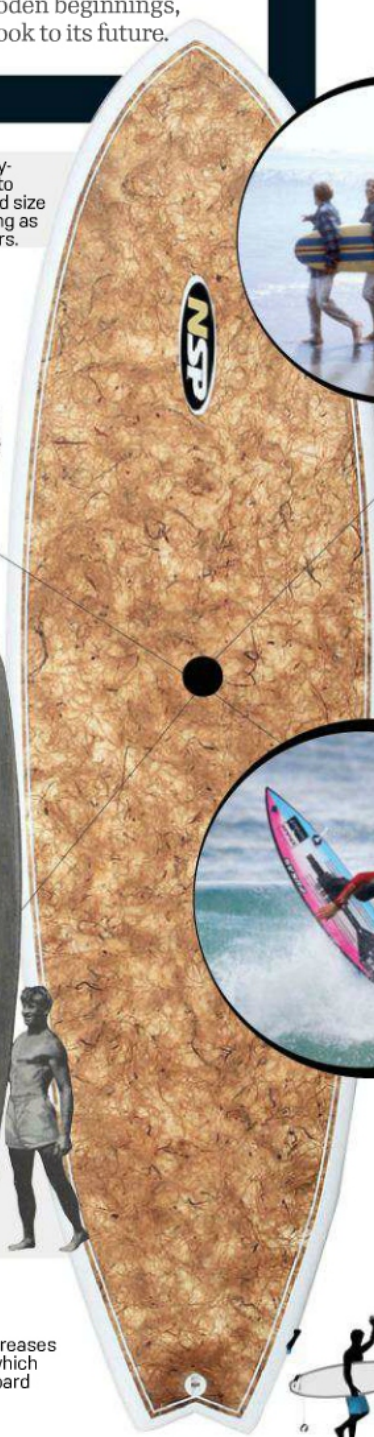
**1971:** Sick of losing his board after wipeouts, Californian Pat O'Neill (son of wetsuit designer Jack) comes up with a DIY solution: suction cup + surgical cord = surf leash.



**FEBRUARY 2011:** Spanish firms Tecnaia and Pukas equip a board with a gyroscope, an accelerometer, a GPS, and strain gauges to gather data. They find surfers experience up to 5 g's during sharp turns.

**NOVEMBER 2011:** Hawaiian Garrett McNamara rides a 90-foot wave—shattering the previous record, a mere 77 feet—off the coast of Nazaré, Portugal.

**2012:** Global Surf Industries layers fiberglass and hand-laid coconut husks over an expanded polystyrene core to create a surfboard (left) that is 25 percent lighter—and 35 percent stronger—than most other boards. Surfboards continue to get more high-tech, thanks to devices like the WaveJet, a water-propulsion system that attaches to the bottom of boards and allows surfers to cut through water at up to 7 mph. Using the device, McNamara paddled into a 45-foot wave; the only way to catch a breaker that big before was to be pulled in by jet ski. Gnarly!



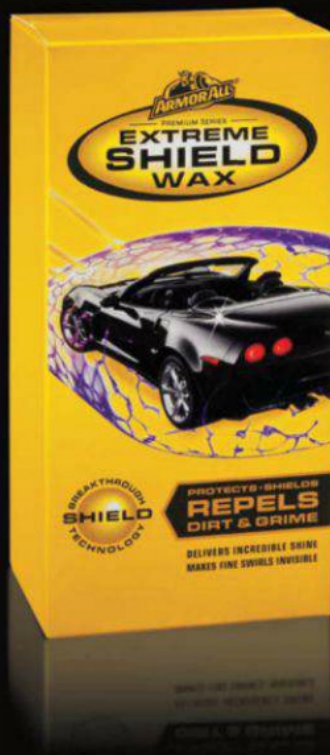




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